ELECTRONIC INDUSTRIES

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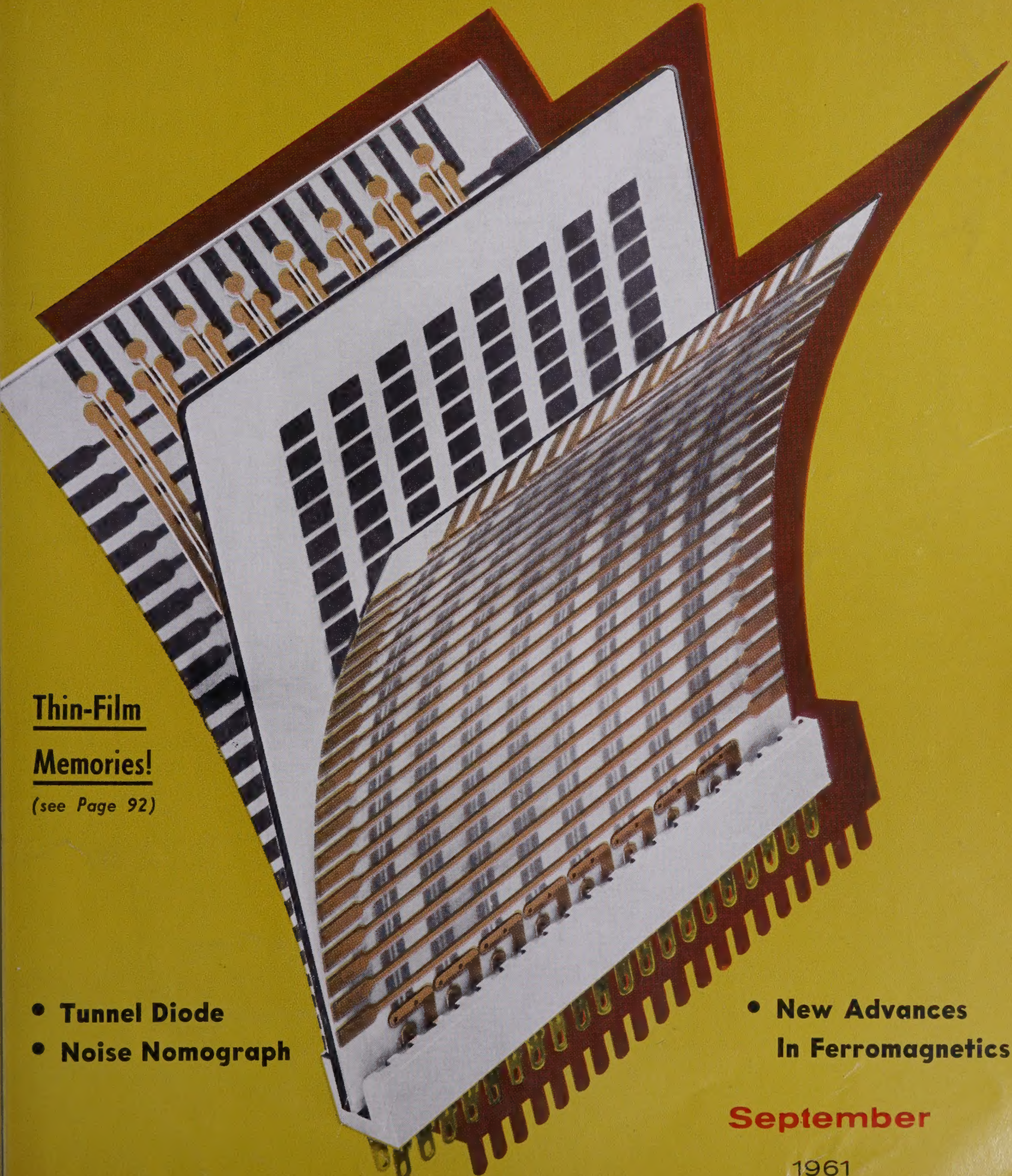


Thin-Film Memories!

(see Page 92)

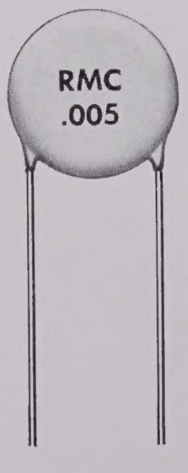
- **Tunnel Diode**
- **Noise Nomograph**

- **New Advances In Ferromagnetics**

September

1961

RMC "JL" DISCAPS



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ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

WE NEED— Nuclear Test Facilities & Standards

ONE of the most disturbing situations confronting the electronic industries to-day is the great lack of information on just how electronic components, products, and systems will perform in nuclear environments. There are no standards available in this area and there seems to be no formal overall program under way to develop such data.

As things stand now, under radioactive fall-out conditions we do not know; a) whether elements contained in the electronic equipment will also become radioactive and hence cannot be handled; b) whether the equipment will be permanently damaged or; c) if the equipment will cease to operate—and if it does, for how long. This lack of information could be catastrophic if the cold war becomes nuclearly warm. Industry, military, civil defense, and individuals will all depend very heavily on "operating" electronic communication, control, and data processing equipment.

From the Electronic Tube Division, Sylvania Electric Products, Emporium, Pa., comes some heartening news in this connection. Under their new program they have begun to circulate information on the ability of electron tubes to withstand certain environments and they are publishing this data as a rating on each of their tube types. In general their tests have shown that vacuum tubes suffer no deleterious effects under radiation, although certain materials such as boron and cobalt should be avoided in manufacture. (In our next issue we shall present further detailed information as to the actual extent and nature of their tests.)

Another heartening news bit in this area comes from the New York State Office of Atomic Development, in Albany. This organization is holding a series of exploratory meetings with representatives from industry. The industry representatives come from individual manufacturing organizations and the aim here is to establish a jointly supported nuclear test center so that extensive radiation testing can be performed. This certainly appears to be a first step in the right direction.

We believe that there is an urgent and vital need to develop full, comprehensive information, test data and standards in this area. There should be a number of nuclear test centers established throughout the United States. These should be strategically located to serve those areas containing electronic manufacturing concentrations. The program deserves the support of all electronic equipment producers and in our opinion also merits financial assistance from Federal and State sources. We shall be watching for all future developments in the field of nuclear testing and shall be reporting these to you on a regular basis.

What Price Reliability?

OVER the past ten years the Military, Government, Industry, and consumers have all come to rely on electronic products more and more to provide the ever increasing gamut of new services. With the Military especially, electronics has become a major support arm. Going along with the new systems and services that electronic technology has made possible, has been the stipulation that the operation of electronic equipment be infallible; i.e., that it be 100% reliable.

This pressure has resulted in a great many study programs, investigations, and analyses but all of these indicate that there is no simple solution to assure absolute reliability. The military procurement procedures, patents, manufacturing know-how, and the state-of-the-art, are only some of the elements having direct bearing on this subject. In this issue the Editors of ELECTRONIC INDUSTRIES have summarized their findings in a special staff report entitled "For the Want of a Nail? or What Price Reliability." This information has been developed from the series of personal field interviews with outstanding reliability authorities all over the United States. We believe that it will be of outstanding importance and interest to all of our readers. It starts on page 141.

ELECTRONIC INDUSTRIES

Vol. 20, No. 9 September, 1961

FRONT COVER: Thin film memory plane, developed by Burroughs Corp., stores (20 x 8) = 160 bits. It can be incorporated into random access memories having cycle times of 0.2 microseconds. Film rectangles are Ni-Fe (81% Ni) 2,000 A. thick, 3/16'' high, 1/8'' wide.

MONTHLY NEWS ROUND-UP

Radarscope: What's Ahead for the Electronic Industries 4
As We Go to Press 7
Electronic Shorts 8
Coming Events 11
Electronic Industries' News Briefs 23
TOTALS: Late Marketing Statistics 25
Snapshots . . . Of the Electronic Industries 28
International News 32
Next Month in Electronic Industries 91
Washington News Letter 208

Editorial 1
A Survey of Thin-Film Technology .... *John Watkins* 92
How to Analyze Feedback in Transistor Amplifiers .. *J. C. Looney* 98
Recent Advances in Ferromagnetics .... *W. J. Polydoroff* 102
Determining Optimum Burn-in for Capacitors .... *L. D. Hines* 105
Fourier Analyzer Uses the Hall Effect *J. D. Williams & S. P. Denker* 108
Tunnel Diode Noise Nomograph .... *L. E. Dickens* 110
A Transmitter Combining Network .... *W. E. Junker* 113
Designing With Teflon .... *Jack Kipnes* 116
Problems of Space Communication: II Nonlinear Receivers *C. T. McCoy* 118
Countermeasures Card File System .... *C. W. Young* 120
What's New 136
What Price Reliability? .... *John E. Hickey, Jr.* 141
International Electronic Sources 183
Electronic Operations 199
Inexpensive Remote Pickup Transmitters .... *P. Whitney* 200
Professional Opportunities 213
Latin American Communication Planning .... *Dr. W. J. Duschinsky* 214
Checklist for Marketing a New Product 218

NEW PRODUCTS & TECH DATA

New Tech Data for Engineers 124
New Products 130

DEPARTMENTS

Tele-Tips 46
Letters 55
Personals 70
Books 80
Systems-Wise 199
Cues for Broadcasters 206
Industry News 223
News of Mfrs. Representatives. 225

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Highlights
of this issue

A Survey of Thin Film Technology — page 92

The new technique of Thin Film provides a direct means to use the physical properties of metals. The recent concentration in this field has led to the development of new electronic concepts. The survey covers the widest scope of this technology and details many interesting breakthroughs of the last few months.

How to Analyze Feedback in Transistor Amplifiers — page 98

The performance of multi-loop feedback amplifiers can be improved using positive feedback. Harmonic distortion and sensitivity to parameter variations can be reduced, signal-to-noise ratio increased, and input and output impedance can be made either high or low. Using positive feedback in general results in a conditionally stable amplifier. A thorough analysis is needed to insure stable operation with adequate phase and gain margins.

Recent Advances in Ferromagnetics — page 102

Here are some of the latest applications of magnetic materials at all frequencies now in use. Some of the interesting applications are a "no silhouette" aircraft antenna, a small FM broadcast antenna for cars and a compact, low cost TV tuner.

Determining Optimum Burn-In for Capacitors — page 105

Burn-in to remove early failures—and increase reliability—has long been accepted. But what is the proper stress to place upon the components? What voltage? What temperature? And, for how long? Here are the details on an answer-seeking study for glass dielectric capacitors.

Fourier Analyzer Uses the Hall Effect — page 108

A system which can determine both the magnitude and phase angles of the Fourier components of a periodic signal is described. The system uses three basic operations: phase shift, multiplication, and averaging. An active tuned circuit provides the phase shift. A semiconductor Hall Effect device is used for multiplication and averaging.

Tunnel Diode Noise Nomograph — page 110

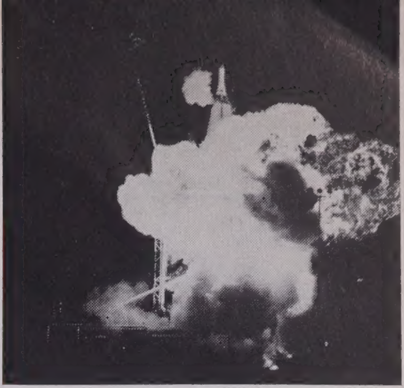
The tunnel diode amplifier is examined theoretically in relation to its noise figure. A nomograph is presented which simplifies the determination of noise, with the effects of frequency on this figure.

Countermeasures Card File System — page 120

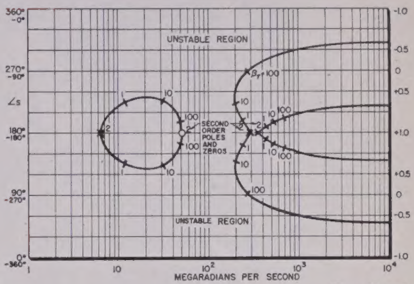
In the battle between Electronic Countermeasures (ECM) and Counter-Countermeasures (CCM) the demand for current useable information is pressing. The card file system discussed in this article works for a large corporation. It may be adopted to any other tech. data file.

What Price Reliability? — page 141

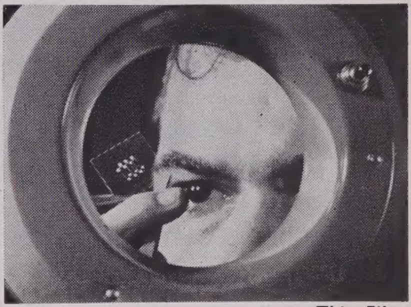
A timely staff report providing an overall view on a most controversial subject. Are present procurement practices right or wrong? Can we push the state-of-the-art and still maintain reliability? What future roles Congress, the military manufacturers and individuals must play.



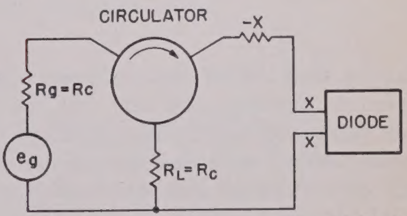
Reliability



Feedback



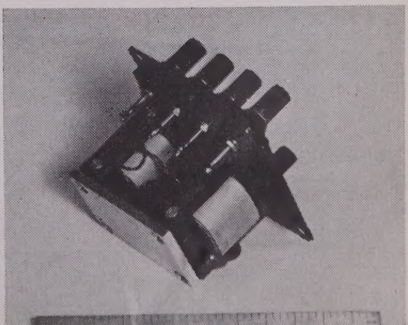
Thin Films



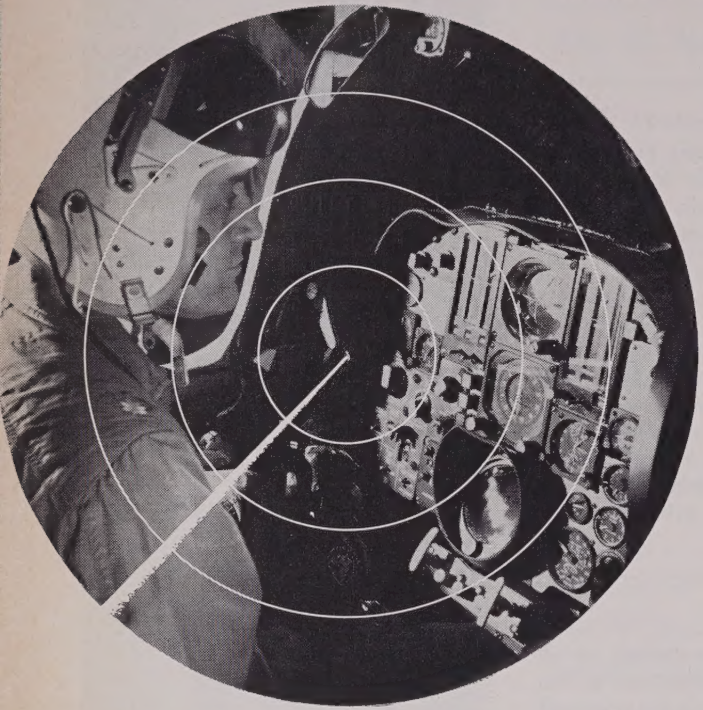
Tunnel Diode

Ferromagnetics

Fourier Analyzer



RADARSCOPE



SIMULATED FLIGHT

Air Force pilot is feeling all the sensations of flight in this simulated cockpit of an F-105D fighter-bomber built for the Air Force by ACF Electronics Div. of ACF Industries Inc.

NASA and AT&T have signed a cooperative agreement to develop and test two, or possibly as many as four, active communications satellites during 1962. AT&T will design and build the satellites at its own expense and will reimburse NASA for the costs of the facilities and services which NASA will furnish in connection with the project. These will include Thor-Delta launch vehicles, launching and tracking facilities, and range and launch crew services. The satellites will be launched from Cape Canaveral, Florida.

SHIPMENTS OF ELECTRONIC COMPONENTS by U. S. producers in the first quarter of 1961 showed little change from the levels of the fourth quarter of 1960, Electronics Division, Business and Defense Services Administration, U. S. Department of Commerce, reports. First quarter changes, however, differed considerably among the various categories of electronic components. Capacitor shipments gained about 9%; resistors, 6%; receiving tubes, 4%; and quartz crystals, 3%. Lower unit prices for some components, particularly semiconductors, tended to limit dollar totals. Physical volume of semiconductor shipments increased 15% to nearly 113 million units, but the dollar volume was up only $2 million—to $146 million.

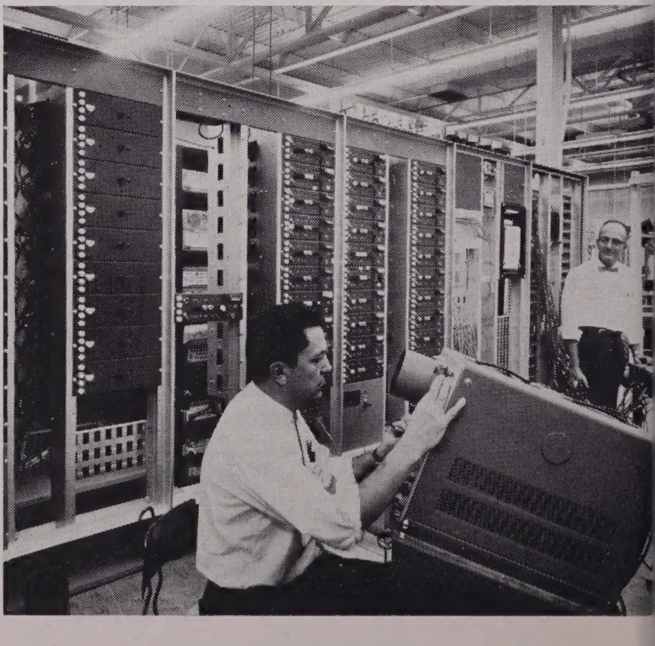
UNITED KINGDOM EXPORTS of electronic products to the United States during the calendar year 1960 totaled $19.6 million—a drop of more than 10% from the record level of nearly $22 million in 1959. Shipments of record playing mechanisms dropped some 34%—from $12.4 million in 1959 to $8.1 million in 1960.

WILL MOLECULAR ELECTRONICS be ready for the consumer market in the near future? It comes as pretty much of a surprise to find that a number of industry spokesmen are optimistic. They're talking about seeing molecular electronics used in radios and hearing aids within 2 to 4 years.

FORTY-TWO ELECTRONICS MANUFACTURERS experienced financial difficulties during the 12 months ended last March 31, compared with 39 during a like period in 1959-60, the EIA's Credit Committee reports. Twenty electronic distributors were similarly involved, as against 15 in the previous fiscal year. Manufacturer liabilities totaled $19,229,000 against $7,815,000 for the previous period. The comparable figures for distributors were $2,684,000 against $2,000,000 the year before. Incompetent management headed the list of failure causes. Components manufacturers still have the highest rate of financial failures; producers of test equipment and instruments are next.

PRODUCTION-CONTROL SYSTEM

At GE's Computer Dept., Phoenix, Ariz., a complete Model 3100 Shoptrol production-control system for factory monitoring and data collection undergoes final checkout. The 3100 comprises a control center, including status monitors installed in groups of 20, shown here, operator control stations, paging selectors.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

SEVERAL ANTICIPATED CONDITIONS of space flight—weightlessness, Van Allen radiation, solar flares, and meteorites—will not pose as great a hazard to man as had been previously imagined, according to researchers at The Martin Company.

PRIMARY ATOMIC FREQUENCY STANDARD has been developed by National Co., under an Air Force contract. The Electron Bombardment Detector produces positive ions (electrically charges particles formed in a gas) a means of detecting carbon monoxide particles has been achieved.

MICROMINIATURE CIRCUITS in future missile and satellite systems will represent a "marriage" of a variety of microelectronic techniques presently under development, says Gerald J. Selvin of Sylvania. He adds that, "Because the techniques and materials used in forming electronic circuit stages will change as time goes on, we can expect a high obsolescence rate in equipment used to produce the electronic materials and circuits. But the method of protecting and interconnecting should not be obsolete."

1961 ENGINEERING GRADUATES of Illinois Institute of Technology received an all-time high in average beginning salaries, earning approximately 5% more than their counterparts in 1960. The new engineers started to work for an average salary of $550 a month, compared with a $525 average the year before. The beginning metallurgical engineer led the salary field this year, earning an average of $590. Electrical engineers received $566 per month this year, compared with $544 last year.

NASA HAS SELECTED RCA to develop a payload capsule for flight-testing electric propulsion engines. RCA's Astro-Electronics Division will design, fabricate and test seven capsules, three for ground tests and four for actual flight tests. Each capsule will carry two electric engines. Complete launch support will also be provided by the chosen contractor. The first test capsule, scheduled to be launched during the last quarter of 1962 by a Scout rocket, will carry one cesium-fueled and one mercury-fueled ion engine.

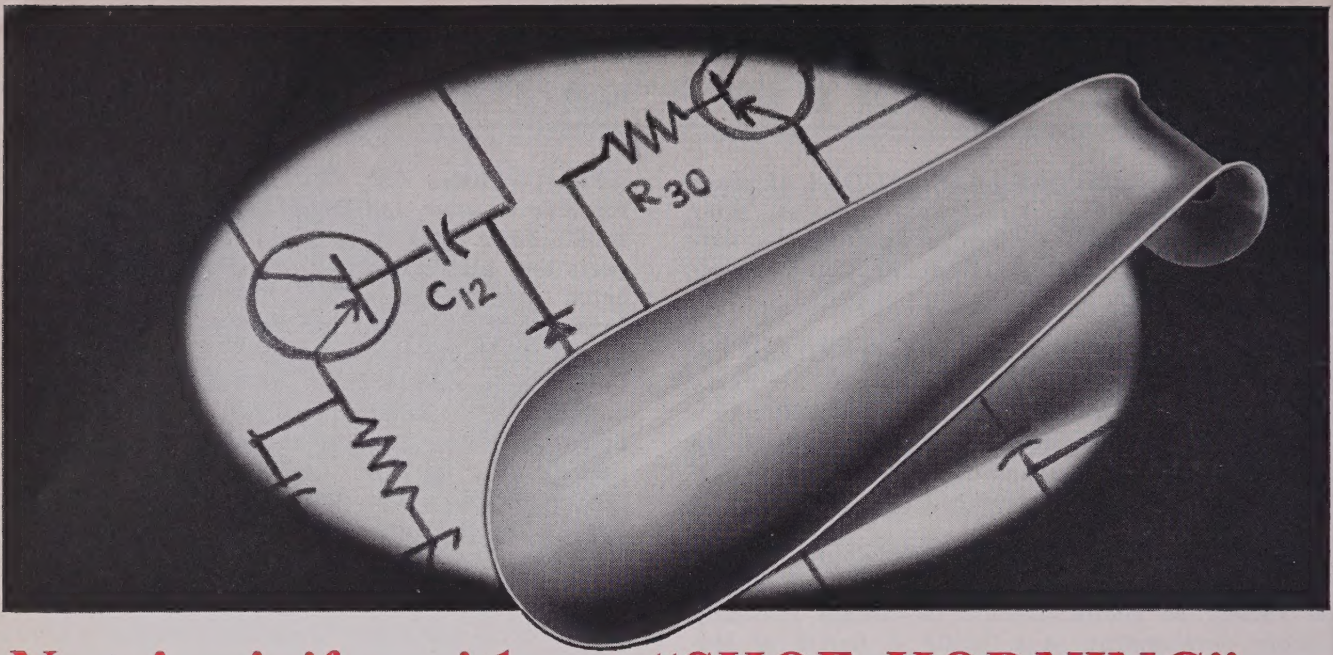
THE CHALLENGE of tomorrow's sophisticated electronics systems must be met today with a development program "highly anticipatory" in nature, according to an Air Force state-of-the-art survey of electronic delay techniques. The report predicts that existing delay systems—with limited potential for improvement—could saddle new electronics systems with deficiencies or serious limitations, and calls for improvement in both media and transducers, including bonding mechanisms, of present quartz ultrasonic delay lines as one step toward decreasing extremely high losses in present microwave materials.

APPLICATIONS OF PRINTED CIRCUIT boards continue to grow, but sharp competition has forced profits down. The Institute of Printed Circuits reports that a recent survey of sales and profits indicated that average profits in 1960 were 3.2% after taxes. This is approximately 20% less than 1959 profits. Sales for the same period were up 36% and totaled approximately $25 million. The IPC estimates than an additional $25 million is produced by companies for internal use. The IPC study shows that sales for 1960 were approximately 58% in military applications and 42% for industrial and commercial applications.

SMALL BUSINESS FIRMS which properly utilize today's readily-available economic and market data can develop profitable long-range plans and forecasts as guides to future operations in meeting predetermined goals, according to a Management Research Summary released by the Small Business Admin. The summary is based on a study made by the Univ. of Minnesota covering 160 small manufacturers in that State. Titled "Forecasting in Small Business Planning," the study was made under a 1959 management research grant from the Small Business Administration. Long-range planning and forecasting by American businesses is fast becoming an indispensable key to successful operation of small firms under present changing economic patterns, the summary says.

WEATHER SATELLITE

RCA Project Manager A. Schnapf notes technical points in one of thousands of cloud photos transmitted to earth by the two Tiros satellites now in orbit. Over the table is Tiros III television infrared observation satellite built for the National Aeronautics and Space Admin. by RCA's Astro-Electronics Div.



Now! minify without "SHOE-HORNING"...

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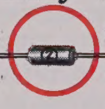
Big boast? No! Plain fact. You need no shoe horn to get high capacitance values into your transistorized circuits. Sprague's ultra-miniature, solid-electrolyte TANTALEX Capacitors let you minify to the hilt without sacrificing performance or reliability! This one,  **for example, is only ⅛″ in diameter by ¼″ long, yet packs a whopping 6.8 μF at 6 volts!**

A Reliable Source of Supply!

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You can get off-the-shelf delivery of Type 150D capacitors at factory prices on pilot quantities up to 499 pieces from your local Sprague Industrial Distributor

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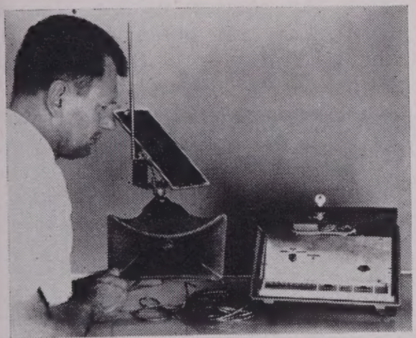
As We Go To Press . . .

Spectrometer to Study Energy Emitted by Stars

Princeton University Observatory has awarded the Perkin-Elmer Corp. of Norwalk, Conn., a contract to develop and build a spectrometer to study ultraviolet energy emitted by stars. The special instrument will be carried above the earth's atmosphere in an Aerobee-Hi rocket. Opacity of the earth's atmosphere prevents similar studies from the ground.

The spectrometer will scan the ultraviolet regions of the spectrum for less than five minutes. When the rocket is from 62 to 143 miles above the earth the ultraviolet light emitted by stars will be recorded. Information will be telemetered back to earth immediately as the spacecraft will be destroyed upon re-entering the earth's atmosphere.

CLEAR SYSTEM



Engineer Don Stellmacher of Hoffman Electronics Corp., Los Angeles, Calif. is shown with elements of CLEAR, a sun-powered radio receiver-public address system designed for use in isolated villages of underdeveloped countries where electric power is lacking. Silicon solar cells are mounted with the loudspeaker. Receiver also serves as an amplifier for public address use.

Special-purpose Antennas

National Bureau of Standards has designed and constructed special-purpose antennas for investigating micropulsations in the earth's magnetic field. These antennas will be used by Dr. W. H. Campbell of the Bureau's Central Radio Propagation Laboratory, Boulder, Colo. to collect data on the behavior of micropulsations and to discover how they can be related to unusual manifestations of solar or magnetic activity. Results of this program are expected to provide information about ionospheric disturbances arising from extraterrestrial sources which may affect radio communications.

DRUMS FOR DEFENSE

Magnesium cushioner (the drum-like cylinder on lathe) for a missile warhead is shown undergoing a turning and facing operation at ACF Electronics Div. of ACF Industries, Riverdale, Md. Such cushioners will eventually contain a high explosive charge in the warhead of the Sparrow III, a Navy air-to-air guided missile.

Cable Extension For Atlantic Missile Range

Air Force Missile Test Center at Cape Canaveral has selected the United States Underseas Cable Corp. of Wash., D. C., to design, manufacture, and install a 700 mile extension to the existing underwater communications network serving the Atlantic Missile Range.

Submarine cable communications provide maximum reliability and instantaneous return of missile tracking and telemetry information from down-range stations to Cape Canaveral. The new cable will be laid from Turks Island to Antigua via Ramey Air Force Base, Puerto Rico.

Weather Bureau Radar-Telemetering Systems

A contract to manufacture Radar-Telemetering Systems has been awarded the Microwave Corp. of America, Stamford, Conn., by the United States Weather Bureau. The systems will employ a new concept of microwave radar technique for the interrogation of remote transponders. They will enable the Weather Bureau to determine exact wind velocity and wind direction simultaneously from numerous points as far as several miles from the central weather station.

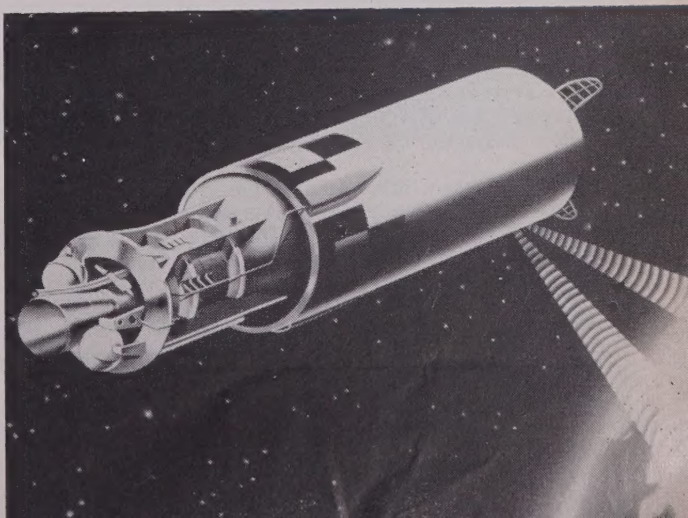
The contract calls for equipment which can ultimately feed information in digital form to electronic computers as a portion of the nationwide weather forecasting system now under study by the Weather Bureau.

Radio Research Facility

A $3,800,000 radio research facility, scheduled to be "on the air" by 1962 is being built for the Air Force in Tyngsboro, Mass. Employing a 120 ft wide saucer shaped antenna, it will be used for global communications and space studies. The Electronic Systems Division at Hanscom Field, one of four divisions of the Air Force Systems Command, is managing the construction. Lincoln Laboratory of Massachusetts Institute of Technology is playing a major role in its design and construction, and upon its completion, will operate and evaluate the facility on behalf of the Air Force.

More on Page 8

RELAY SATELLITE



Artist's concept of an active relay satellite in which a solid state microwave transmitter and receiver developed by Sylvania Electric Products Inc., Amherst, N. Y., could be used. Transmitter is designed for S-band operation with 2 watts output. Receiver is the size of a transistor portable radio.

Electronic SHORTS

▸ NASA and AT&T have signed a cooperative agreement for the development and testing of two or possibly as many as four active communications satellites during 1962. AT&T will design and build the satellites at its own expense, and will reimburse NASA for the costs of its facilities and services. The satellites will be launched from Cape Canaveral, Fla.

▸ FCC has invited comments to Notice of Proposed Rule Making looking toward doing away with present separate classifications of AM, FM, and TV (aural) studio-transmitter-link (STL) stations and to combine them into a single category to be called Aural Broadcast STL stations.

▸ A system under development by G. E. will use a continuous signal to calculate a missile's position and velocity in space at all times. The MISsile TRAjectory Measurement System (MISTRAM), is an application to radar measurements of the interferometer principles used by astronomers for precise measurements. Colorado Research Corp. has been contracted to design and manufacture microwave refractomers for the system.

▸ Acoustical studies of aircraft noise at selected airports throughout the country will be made by Polysonics, Washington, D. C., aviation acoustical consultants, under a contract with the FAA. Airports to be surveyed will include Washington National, New York International (Idlewild), and Baltimore Friendship International. Data obtained will aid in the planning of new airports, runway locations, land use, and in noise abatement procedures.

▸ Nuclear physicists at the Bartol Research Foundation of the Franklin Institute have concocted a special concrete to shield their new atomic research laboratory in Springfield, Pa. With one-foot thick walls, floor and ceiling made from the special concrete mix, background radiation is cut to about one-sixth of what it is in other parts of the laboratory.

▸ Bureau of Ships has awarded the Electronic Tube Corp. of Phila., Pa., two contracts for production of miniature, fully transistorized oscilloscopes. Except for the CRT no vacuum tubes are used. The Bureau proposes to use them on Polaris carrying submarines.

▸ A recorder introduced by the Westrex Co. of Hollywood, Calif., can be actuated by the sound of a voice and automatically stamps the time and date on the magnetic tape. It begins recording within 10 msecs. after a voice signal is detected, assuring that no intelligence is lost.

▸ Operation of portable FM receivers aboard aircraft has been forbidden by the FAA. Tests show that the local oscillator of some FM receivers generate signals which interfere with aircraft navigation.

▸ Directorate of Procurement and Production of the Rome Air Material Area has placed an order with Temco Electronics, Dallas, for video correlators. The correlators will be used to modernize the FPS-6 radars which are part of the SAGE (Semi-Automatic Ground Environment) electronic communications and command system.

▸ Transitron Electronic Corp. and Western Electric Co. have signed a cross-license patent agreement, resulting in the withdrawal of WE's patent infringement suit against Transitron and its claim for past damages. The agreement provides for a complete interchange and availability of semiconductor patents between the two Co's.

▸ The Italian Navy has purchased a Hughes Aircraft Co. Frescan 3-D radar system from the U. S. Navy. Installation of the electronic scanning radar on the Italian missile cruiser Garibaldi will be completed this winter under the direction of Italian personnel.

▸ According to a tabulation prepared by the Bureau of the Census, U. S. Department of Commerce, three out of every four households had telephones in March 1960. The tabulation was based on data assembled in connection with its Current Population Survey.

▸ The Martin Co. has completed a feasibility study for NASA on Project APOLLO, the space flight system planned to carry three men around the moon during the mid-sixties. APOLLO will serve as a basis for future space explorations and for lunar landings.

As We Go To Press (cont.)

AF Receives Production Model of New HF Radar

First production model of the new FPS-26 radar has been turned over to the USAF at Hunter Air Force Base near Savannah, Ga. The FPS-26 is a high powered, height finder radar which has been designed and constructed to work well under the most adverse conditions. Made by Avco Corp., Cincinnati, Ohio, the new radar will operate in conjunction with long range search radars at various Air Force installations around the North American Continent.

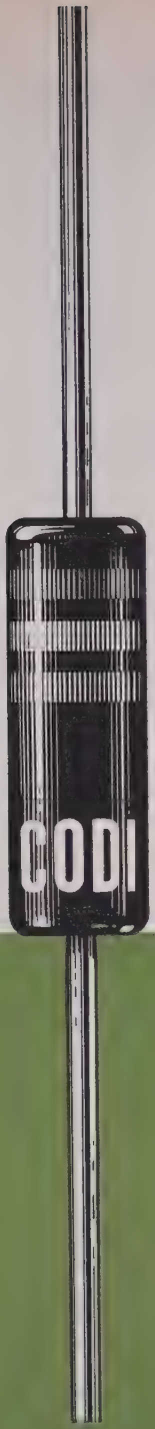
Unfurlable Antennas

Antennas that can be packed into containers about the size of a box camera and then expanded to full size arrays on command are being investigated for the Air Force Systems Command (AFSC). These antennas can be erected by mechanical or pressure techniques after the carrier vehicle obtains orbit. They are potentially useful for satellite-to-satellite communications and weather mapping.

Experimental models designed by the Lockheed Missile and Space Div., Sunnyvale, Calif., and the Schjeldahl Co., Northfield, Minn., have been delivered to AFSC's Aeronautical Systems Div., Dayton, Ohio.

SCAN-A-GRAPH FLIGHT INFORMATION SYSTEM

Eastern Air Lines ticket agent selects for viewing in a recessed monitor one of six channels carrying flight information at the new Atlanta Airport. Scan-a-graph System, designed and built by Nord Photocopy & Electronics Corp. of New Hyde Park, N. Y., transmits static information without vidicon camera or lights over coaxial cable.



Manufacturers of glass silicon diodes
which meet the most challenging requirements of our industry's
high-temperature, low-leakage, fast-switching technology.

COMPUTER DIODE
CORPORATION

250 GARIBALDI AVENUE • LODI, NEW JERSEY • PRESCOTT 3-2511 • CABLE ADDRESS: CODI LODI

Circle 3 on Inquiry Card

IN ELECTRONICS . . . AVIONICS . . . ASTRIONICS

STEMCO THERMOSTATS

RANK FIRST IN PRECISION TEMPERATURE CONTROL

In today's military and commercial projects, you can't afford to overlook any one of these important areas: Reliability, Size, Availability, Economy.

And because Stevens is in production now on the largest number of different types and styles of bimetal thermostats, all these advantages are yours automatically when you specify Stemco thermostats.

1st in Reliability. Proven designs, latest production techniques, most stringent inspection procedures.

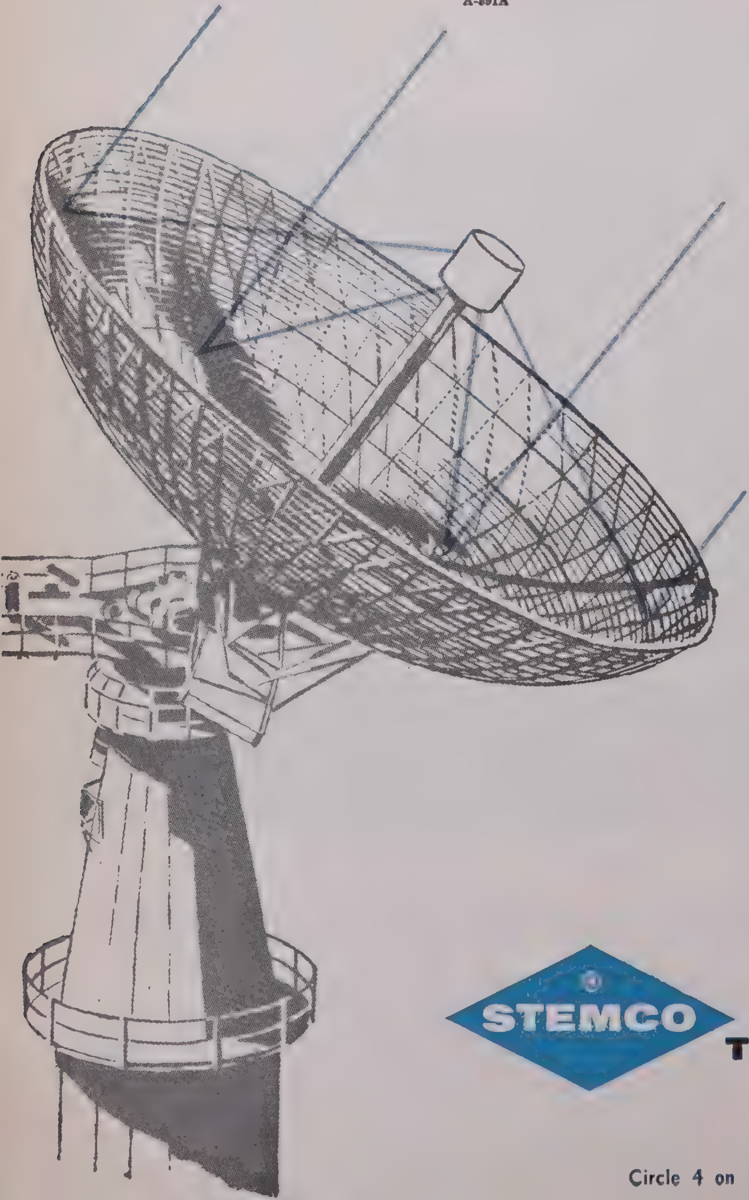
1st in Size. Stemco thermostats score in compactness and lightness without sacrificing performance.

1st in Availability. Tooling for most types is in existence. Flexibility of design cuts lead time on other types.

1st in Economy. Mass production of many standard Stemco types with hundreds of terminal arrangements and mounting brackets cuts your costs.

**Refer to Guide 400EO for U.L. and C.S.A. approved ratings.*

A-891A



TYPE A* semi-enclosed. Bimetal disc type snap action thermostats; give fast response to temperature changes. Can be made to open on rise or close on rise. Single-throw with double make and break contacts. Operation from -20 to 300°F. Lower or higher temperatures on special order. Average non-inductive rating 13.3 amps, 120 VAC; 4 amps, 230 VAC and 28 VDC. Various mountings and terminals available. Bulletin 3000.

TYPE A hermetically sealed. Electrically similar to semi-enclosed Type A. Various mountings, including brackets, available. Bulletin 3000.

TYPE MX hermetically sealed. Snap acting bimetal disc type units to open on temperature rise. 2 to 6°F differentials as standard. 1 to 4°F differentials available on special order. Depending on duty cycle, normal rating 3 amps, 115 VAC and 28 VDC for 250,000 cycles. Various terminals, mountings and brackets available. Bulletin 6100.

TYPE MX semi-enclosed. Construction and rating similar to MX hermetically sealed type. Bulletin 6100.

TYPE M hermetically sealed. Bimetal disc type, snap acting thermostats. Also available in semi-enclosed. Operation from -20 to 300°F. Lower and higher temperatures available on special order. Depending on application, rated non-inductive 10 amps, 120 VAC; 3 amps, 28 VDC. Various terminals, wire leads and brackets available. Bulletin 6000.

TYPE C hermetically sealed. Also semi-enclosed styles. Small, positive acting with electrically independent bimetal strip for operation from -10 to 300°F. Rated at approximately 3 amps, depending on application. Hermetically sealed type can be furnished as double thermostat "alarm" type. Various terminals and mountings. Bulletin 5000.

STEMCO THERMOSTATS

STEVENS *manufacturing company, inc.*
P.O. Box 1007, Mansfield, Ohio

Circle 4 on Inquiry Card

Coming Events in the electronic industry

Sept. 3-8: **Nat'l. Mtg., American Chemical Soc.**; Chicago, Ill.

Sept. 5-8: **16th Nat'l. Conf. of the Assoc. for Computing Machinery & 1st Internat'l. Data Processing Exhib.**; Statler-Hilton Hotel, Los Angeles, Calif.

Sept. 6-8: **Annual Mtg. (Joint) Assoc. of the U. S. Army & Army Aviation Assoc. of America**; Sheraton-Park Hotel, Washington, D. C.

Sept. 6-8: **Nat'l. Symp. on Space Electronics & Telemetry**, IRE(PGSET); Univ. of New Mexico, Albuquerque, N. Mexico.

Sept. 6-8: **Midwest Conf. on Fluid and Solid Mechanics**; Kellogg Center, East Lansing, Mich.

Sept. 6-8: **Joint Nuclear Instrumentation Symp.**, ISA, AIEE, IRE; North Carolina State College, Raleigh, N. C.

Sept. 6-13: **Internat'l. Conf. on Electrical Engineering Education**, ASEE, IRE (PGE), AIEE; Sagamore Conf. Center, Syracuse Univ., Adirondacks, N. Y.

Sept. 7: **7th Road Show of the Electronics Engineering Representatives**; Pines Ridge Country Club, Westchester, N. Y.

Sept. 8-10: **1961 Chicago High Fidelity & Home Entertainment Show**; Palmer House, Chicago, Ill.

Sept. 10-12: **Mtg. of the Chemical Market Research Assoc.**; Lake George Sagamore Hotel, Bolton Landing, N. Y.

Sept. 11-15: **16th Annual ISA Instrument-Automation Conf. & Exhibit**, ISA; Biltmore Hotel & Los Angeles Memorial Sports Arena, Los Angeles, Calif.

Sept. 11-15: **Marine Sciences Instrumentation Symp.** (with 24th Annual Mtg. of the American Soc. of Limnology and Oceanography), ISA; Woods Hole Oceanographic Institution, Woods Hole, Mass.

Sept. 11-15: **Internat'l. Industrial Conf.**, Stanford Research Institute, Nat'l. Industrial Conf. Board; Fairmont Hotel, San Francisco, Calif.

Sept. 12: **Plastics for Tooling**, Central Indiana Section SPE; Hotel Severin, Indianapolis, Ind.

Sept. 12-15: **Industrial Building Exposition**; New York Coliseum, N. Y.

Highlights '62

IRE Internat'l. Conv., Mar. 26-29, Coliseum & Waldorf-Astoria Hotel, New York, N. Y.

WESCON, Aug. 21-24, IRE, WEMA; Los Angeles, Calif.

Nat'l. Electronics Conf., Oct. 9-11, IRE, AIEE, EIA, SMPTE; Chicago, Ill.

NEREM (Northeast Res. & Eng. Mtg.) Nov. 13-15, IRE; Boston, Mass.

Sept. 13-15: **Annual Mtg. of the Human Factors Soc.**, Ohio State Univ., Battelle Memorial Inst., North American Aviation, Inc.; Ohio State Univ., Columbus, Ohio.

Sept. 13-17: **Annual New York High Fidelity Music Show**, Institute of High Fidelity Manufacturers; New York Trade Show Bldg., N. Y.

Sept. 13-17: **Nat'l. Hobby & Science Exposition**; New York Coliseum, N. Y.

Sept. 14-15: **IRE Conf. on Technical-Scientific Communications**, Nat'l. PGEWS & Phila. Sec. of IRE; Bellevue-Stratford Hotel, Phila., Pa.

Sept. 14-15: **9th Annual Engineering Management Conf.**, IRE (PGEM), ASME; Hotel Roosevelt, New York, N. Y.

Sept. 15-17: **ARRL New York State Conv.**, ARRL; Hotel Niagara, Niagara Falls, N. Y.

Sept. 17-20: **Petroleum Industry Conf.**, AIEE; Jung Hotel, New Orleans, La.

Sept. 18-20: **10th Annual Mtg. Standards Engineers Soc.**; Hotel Sherman, Chicago, Ill.

Sept. 20-21: **Industrial Electronics Symp.**, IRE (PGIE), AIEE, ISA; Bradford Hotel, Boston, Mass.

Sept. 21-23: **Autumn Mtg. N. Y. State Soc. of Professional Engineers**; Glen Falls, N. Y.

Sept. 21-24: **Aerospace Panorama**, Air Force Assoc.; Trade & Conv. Center, Phila., Pa.

Sept. 24-27: **Nat'l. Power Conf.**, AIEE, ASME; St. Francis Hotel, San Francisco, Calif.

Sept. 25-28: **2nd Industrial Building Exposition & Congr.**; Coliseum, New York, N. Y.

Sept. 25-28: **Nat'l. Fall Mtg. of the American Welding Soc.**; Hotel Adolphus, Dallas, Tex.

Sept. 27-28: **Symp.: High Energy Rate Forming**, ASTME; Statler-Hilton Hotel, Detroit, Mich.

Sept. 28-29: **Nat'l. Conf. & Tech. Exhibit of the American Production and Inventory Control Soc.**; Pick-Congress Hotel, Chicago, Ill.

International

Sept. 4-9: **Conf. on Plasma Physics and Controlled Nuclear Fusion Research**, Internat'l. Atomic Energy Agency; Salzburg, Austria.

Sept. 14-25: **Nat'l. Exhibition of Radio and Television**; Parc des Expositions, Paris, France.

Sept. 25-30: **Internat'l. Conf. on Magnetism and Crystallography including Symp. on Electron and Neutron Diffraction**; IUPAP, IUC; Kyoto, Japan.

Sept. 28-Oct. 1: **Symp. on Radioactive Metrology**; Oxford, England.

"CALL FOR PAPERS"

1962 Southwestern IRE Conf., April 11-13, 1962. Submit title of paper and author's name to: Professor Martin Graham, Rice University, Computer Project, Houston 1, Texas. **Deadline: Oct. 1, 1961.**

1962 Electronic Components Conf., May 8-10, Washington, D. C. Papers to deal with new developments in components, component processing techniques, component evalution and component materials. **Deadline** for 500 word summaries (15 copies) is **October 9, 1961.** Forward to: Mr. Henry A. Stone, Chairman, Technical Program Committee, Bell Telephone Labs., Murray Hill N. J.

1962 IRE Internat'l. Conv., Mar. 26-29, 1962, Waldorf Astoria and Coliseum, New York, N. Y. Only original papers not published or presented prior to the 1962 IRE Conv. will be considered. Papers may be on any field associated with or in Electronics. **Deadline** for 100 word abstracts (3) and 500 word summary (3): **Oct. 20, 1961.** Forward to: Dr. Donald B. Sinclair, Chairman, 1962 Technical Program Committee, The Institute of Radio Engineers, Inc., 1 E. 79th St., New York 21, N. Y.

1962 Internat'l. Solid-State Circuits Conf., Feb. 14-16, Phila., Pa. Papers to deal with circuit properties, circuit philosophy, and design techniques related to solid-state devices. **Deadline** for 300 to 500 word abstracts is **Nov. 1, 1961.** Forward to: Mr. Richard H. Baker, Room C-237, MIT Lincoln Laboratory, Lexington, Mass.

Symp. on Electromagnetic Theory and Antennas, June 25-30, 1962,

(*Continued on page* 12)

GALVANOMETERS
for Precise Null Indication

ELECTRONIC

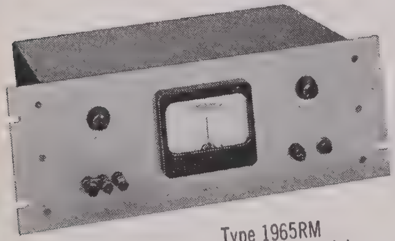
Shallcross Electronic Galvanometers are mechanically and electrically designed for rapid, maintenance-free laboratory and production testing. The extremely high sensitivity detects the balance point immediately . . . minute deflections are registered instantly. Meter becomes balanced in less than one second. Adjustments are quickly made from front of panel.

Current sensitivity is greater than 1×10^{-10} amps.

Voltage sensitivity is greater than 0.5 μv/scale division.

Electronic galvanometers are available in both table and rack-mounting models. Delivery is immediate. Ask for Bulletin L-47.

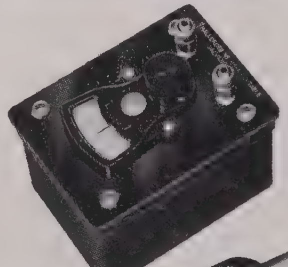
Type 1965
table model


Type 1965RM
rack mounting model

MOVING COIL

These rugged Shallcross taut-suspension galvanometers are widely used in potentiometer and bridge circuits where precise balance indication is needed at low cost.

Complete instruments or their systems are available in sensitivities of 0.5, 1, 2, or 4 μa/mm scale division. Complete specifications are in Bulletin L-47.


Type 315

Type 1951
system

Shallcross

SHALLCROSS MANUFACTURING CO., Selma, N. C.

Coming Events

(Continued from page 11)

The Technical Univ. of Denmark, Copenhagen, Denmark. Papers will deal with: Electromagnetic fields in anisotropic media; Diffraction theory; Antenna pattern synthesis; and Quasi-static electromagnetic problems. **Deadline** for 800-1200 word 3 page summary is **December 1, 1961.** Forward to: Technical Program Committee, The Technical Univ. of Denmark, Oster Voldgade 10 G, Copenhagen K Denmark.

ENGINEERING EDUCATION

Short courses at leading institutions, of interest to electronic engineers.

Human Engineering

9th Annual Human Engineering Institute, Oct. 3-6, 1961. Program presents latest concepts and current trends. Subjects covered include: Man-Machine Dynamics; Workplace Layout and Environment; Decision-Making; Training; and Management. Displays of equipment, films and tech. information will be demonstrated. For further information, **applications accepted through Sept. 15,** contact: Dr. Jerome H. Ely, Director, Human Engineering Institue, Dunlap and Assoc., Inc., 429 Atlantic St., Stamford, Conn.

Space Communications

University of California, Engineering Extension, is offering a short course in "Space Communications," for communication engineers desiring to extend their knowledge of this expanding field. Date: **Sept. 5-15, 1961.** Inquiries and applications for admission should be addressed to: Dept. K, University of California, Los Angeles 24, Calif.

X-ray

40th Norelco X-ray Analytical School to be held **Sept. 11-15, 1961** at the Sir Francis Drake Hotel, San Francisco, Calif. Registration opened, no charge for course, to chemists, metallurgists, physicists, production supervisors, quality control engineers and others interested in X-ray diffraction, diffractometry and spectrography. Contact Philips Electronic Instruments, 750 South Fulton Ave., Mount Vernon, N. Y.

Plant Layout

Univ. of California, Depts. of Engineering and Engineering Extension, is offering a one-week Short Course, **Sept. 17-22, 1961,** in Plant Layout, Material Handling, Warehousing and Shipping. Seminar and workshop for management and supervisory personnel is open to men and firms anywhere in U. S. For program and application write to: Dr. Sam Houston, Dept. K, Univ. Extension, Univ. of Calif., Los Angeles 24 Calif.

Circle 5 on Inquiry Card

PSI SUPER FUSE CLIP RECTIFIERS

1500V @ .5A thru 20,000V @ .2Amp

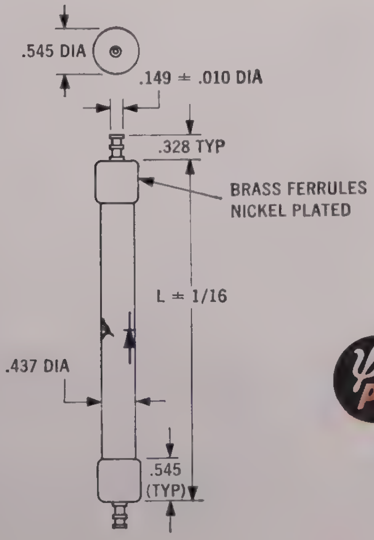
NO VOLTAGE DERATING —65°C to 175°C

EXCEED MIL-S-19500B • ALL-WELDED • SHATTERPROOF
ELECTRICALLY "COLD" CASE • HIGH MOISTURE INTEGRITY
VERSATILE MOUNTING • VOLUME AVAILABILITY

These are tough, rugged Very High Voltage rectifiers made to give trouble-free performance under the most strenuous environmental conditions. They have the lowest voltage drop, the highest current ratings and best reverse leakage characteristics of any cartridge rectifier available!

Type	PIV	I_o @ 25°C	I_o @ 100°C	I_R @ PIV @ 25°C	Length
PS1441	1,500V	500mA	250mA	1 μA max	1 13/16"
PS1445	5,000V	300mA	150mA	1 μA max	2 1/2"
PS1450	10,000V	250mA	125mA	1 μA max	4 5/16"
PS1455	15,000V	200mA	100mA	1 μA max	6 1/16"
PS1460	20,000V	200mA	100mA	1 μA max	6 1/16"

Inverse current @ PIV @ 100°C 50μA max.



U. S. PAT. NOS. 2815474, 2979645

The above types are examples of the 20 Super Fuse Clip Rectifiers covering the 1500V to 20,000 PIV range. Ask about other PSI high voltage rectifiers including 1N1731, 1N1733 and 1N1734 to MIL-S-19500B/142 (Sig C). The new 24-page brochure, "PSI Special Assemblies" gives full details.

For prices, delivery schedules and other details phone, wire or write a PSI sales office near you.

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.

12955 Chadron Avenue, Hawthorne, Calif. • Cable: PSISOCAL
OR 8-4711, OS 9-2281 TWX: HAW CAL 4270

Distributor stocks in major electronic centers coast-to-coast

Circle 6 on Inquiry Card

A SIGNIFICANT BREAK-THROUGH IN TRANSISTOR TECHNOLOGY...

ECDC*

ELECTRO- CHEMICAL DIFFUSED COLLECTOR

The Best High-Power, High-Speed Switching Transistors Ever Developed Provide the Optimum Combination of Voltage, Power, and Speed

The Sprague ECDC Transistor is the first to combine the optimum features of the electro-chemical precision-etch techniques and diffused collector techniques in one highly-mechanized process.

The ECDC Transistor meets these 7 conditions for an "ideal." transistor:

1. Very low collector-to-case thermal resistance through the utilization of high thermal conductivity material as the collector body, resulting in high power dissipation.
2. Thin base width for high radiation resistance and lower storage time.
3. Precision-etched emitter pit permits placement of emitter junction at proper resistivity for optimum breakdown voltage and frequency response.
4. High conductivity surface surrounds emitter pit and close emitter-to-base spacing results in extremely low base resistance.
5. Precision-etched collector provides optimum control of collector series resistance with attendant low saturation voltage, low storage time, and high breakdown voltage.
6. Low collector series resistance as a result of the use of high conductivity material for the mass of the collector area.
7. The structure and manufacturing processes are suited for automated production equipment with immediate in-process feedback.

TYPES 2N2099 & 2N2100

Sprague's new Types 2N2099 and 2N2100 are the first registered types available in the ECDC Transistor family. These P-N-P Germanium Electro-Chemical, Diffused-Collector Transistors are especially designed for high current core driver applications. They feature excellent beta linearity from less than 1 ma to over 400 ma, high frequency response, and low saturation resistance. The low-height TO-9 case is ideally suited to meet equipment designers' needs.

For prompt application engineering assistance, write Commercial Engineering Section, Transistor Division, Sprague Electric Company, Concord, N. H.

For Engineering Data on ECDC Transistors, write Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

*Trademark of Sprague Electric Co.

SPRAGUE COMPONENTS

TRANSISTORS
CAPACITORS
MAGNETIC COMPONENTS
RESISTORS
INTERFERENCE FILTERS
PULSE TRANSFORMERS
PIEZOELECTRIC CERAMICS
PULSE-FORMING NETWORKS
HIGH TEMPERATURE MAGNET WIRE
CERAMIC-BASE PRINTED NETWORKS
PACKAGED COMPONENT ASSEMBLIES
FUNCTIONAL DIGITAL CIRCUITS

SPRAGUE®
THE MARK OF RELIABILITY

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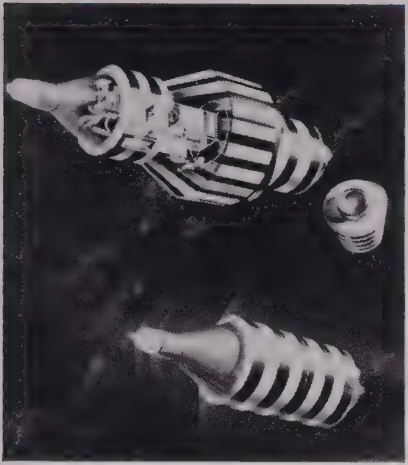
Circle 7 on Inquiry Card

As We Go To Press . . .

SPACE LABORATORY



Artist's drawing shows expandable structures in space proposed by Aeronutronic Div. of Ford Motor Co., Newport Beach, Calif. Structure in orbit at top has been expanded to provide laboratory area for space experimentation. Boost configuration at right prepares to rendezvous. Configuration at bottom is going into orbit.

APATS Checks Satellites

A contract for the construction and installation of an automatic programmer and test system (APATS) for the monitoring and testing of satellites in an environmental chamber has been awarded the Radio Corporation of America by Lockheed Missile and Space Division. The equipment will initially be used to check the MIDAS and Discoverer satellites. The satellites will be tested in a vacuum chamber that simulates outer space environmental conditions.

Integration Pushed For Computer-Control Systems

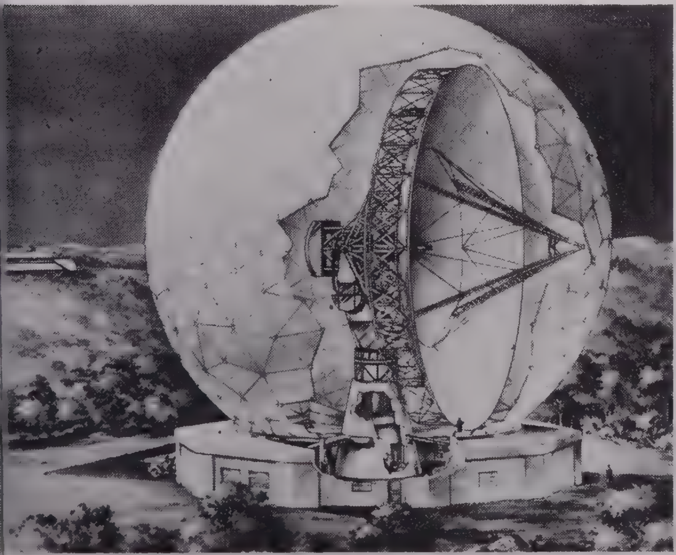
"Industry needs and wants single supplier responsibility, when it buys industrial control systems built around computers," commented Mr. T. Fort, Westinghouse Vice President, at a recent computer symposium.

It is felt that the piecemeal buying of a control system, separately from the control computer, is illogical, because, in the long run money is lost, not saved, through the inefficiency of the over-all system. A computer must be perfectly matched to its control system for real dollar savings.

The more logical approach of purchasing an integrated computer and control system is coming to the fore. It is still not widely accepted, but the door is open. System users are starting to concede that more money is saved with an integrated, well planned total system.

The manufacturer's thinking is also changing. He is starting to push the integrated concept—for reliability and money savings. A manufacturer is more willing to accept responsibility when he has produced the entire system. He can produce a more efficient, better utilized total system, if given complete charge.

This changing of concepts will result in more effective use of a system, more efficiency per dollar, a healthier relationship between manufacturer and buyer, and a widening, progressive market for control systems and control computers.



HAYSTACK ANTENNA

Artist's conception of USAF's Haystack Hill Radio Research Facility, Tyngsboro, Mass., slated to be the most powerful in the world. It will use 100,000 w. plug - in transmitters being built by Radiation at Stanford, Palo Alto, Calif. Transmitters will fit into cab mounted directly behind antenna, rotating with it inside the dome.

COMPUTER VOICES

Executive committee of American Federation of Information Processing Societies are (l to r), R. A. Imm, IBM Corp., and representative of the AIEE; Dr. H. Huskey, Univ. of Calif., representative of ACM; Dr. W. H. Ware, Computer Sciences Dept., RAND Corp., Chairman of the AFIPS governing board; and Dr. A. A. Cohen, Remington Rand Univac, representative of the IRE. AFIPS was formed to organize the advancement and diffusion of knowledge of information processing societies at all levels and to all media.

Weather Bureau Accepts Data Processing System

U. S. Weather Bureau has accepted for use in its "Flying Electronics Laboratories" the first of three airborne digital instrumentation systems designed and manufactured by Ess Gee, Inc., Elmsford, New York. The equipment, which will be the heart of the Bureau's National Severe Storm Research Aircraft Project, has been designed to process approximately 40 different parameters measured in flight. Measurements include weather information such as wind speed, wind direction, air temperature, humidity, pressure and water content, as well as aircraft information such as ground speed, latitude and longitude, roll and pitch angle, drift angle, and many others.

Tele-Processing Network To Speed Air Reservations

Delta Airlines has ordered the IBM 9074 SABRE airline reservation system which will make up-to-the-second flight and passenger information available instantly to its reservations agents in 66 cities. The IBM Tele-processing network will link nearly 300 remotely located electronic agent terminals to a powerful computer center.

Installation of the system will begin in April, 1963, with the computer center planned for Delta headquarters in Atlanta. The computer center will maintain continually updated information about seat inventory and availability and flight schedules. Full employment will be maintained when SABRE is installed.

FREQ. STDS.

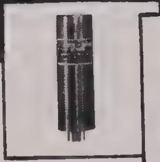
AND TUNING FORK OSCILLATORS

TYPE 10, ACTUAL SIZE

SIZE, 1-3/8" x 1-3/8" x 3/8"

This frequency standard (360 or 400 cy.) is accurate to ± 25 parts per million at 10° to 35°C. The tuning fork is made from Iso-elastic alloy and is approximately 1 inch long. Fork aging has been greatly minimized. Compensation in the circuit provides a minimum rate change throughout the useful life of the power cell (over a year). External power of 1.4 volts at approximately 6 microamperes can also power the unit. An hermetically sealed model, Type 15, is also available.

TYPE 2007



TYPE 15

For more than 20 years, this company has made frequency standards and fork oscillators within the range of 30 to 30,000 cycles for applications where consistent accuracy and rugged dependability are demanded. A few examples are shown and described here.

Some users integrate these units into instruments of their own manufacture. Others rely on our experience and facilities to develop complete operating assemblies to meet their special needs.

You are invited to submit any problems within the area of our activities for study by our engineering staff.

TYPE K-5A FREQUENCY STANDARD

Size, 3½" x 3" x 1¾"
Weight, 1½ lbs.
Frequency: 400 cycles
Accuracy: .03%, —55° to + 71°C
Input: 28V DC ±10%
Output: 400 cy. approx. sq. wave
at 115V into 4000 ohm load (approx. 4W)

TYPE 2007-6 FREQUENCY STANDARD

Transistorized, Silicon type
Size, 1½" dia., x 3½" H., Wt., 7 oz.
Frequencies: 360 to 1000 cy.
Accuracies:
2007-6 ± .02% (—50° to +85°C)
R2007-6 ± .002% (+15° to +35°C)
W2007-6 ± .005% (—65° to +85°C)
Input: 10 to 30V DC at 6 ma.
Output: Multitap, 75 to 100,000 ohms

TYPE 25 PRECISION FORK

Size, ⅝" dia. x 2³⁄₁₆"
Weight: 2 ounces
Frequencies: 200 to 1000 cy. (specify)
Accuracies:
R-25T and R-25V ± .002% (15° to 35°C)
25T and 25V ± .02% (—65° to 85°C)
For use with tubes or transistors.

TYPE 15 FREQUENCY STANDARD

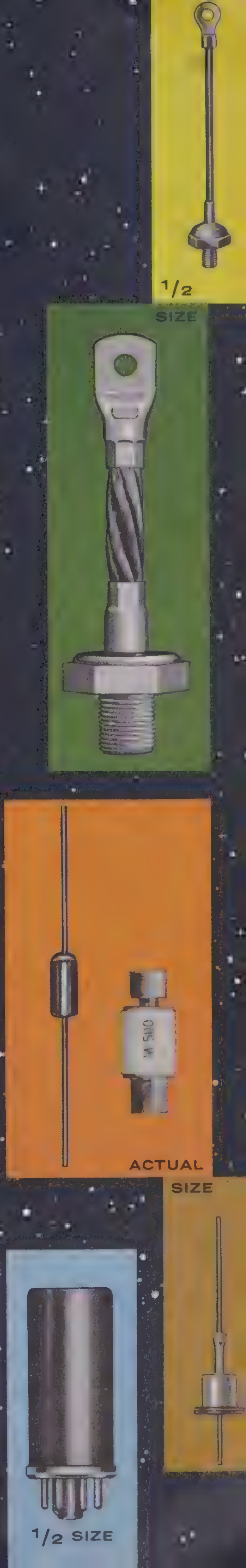
Similar to Type 10 (illustrated) except
with silicon transistor, hermetically sealed
and vibration resistant.
Size, 1" x 2" x 2" high
Tolerance, ± .01% from —40°C to + 71°C
Output: .IV at 50,000 ohms source impedance.

ATP INC.

AMERICAN TIME PRODUCTS, INC.
61-20 Woodside Ave., Woodside 77, L.I., N. Y.

INVITATION TO INVENTION

IN CIRCUIT DESIGN



WHERE HIGHEST QUALITY IS IN VOLUME PRODUCTION

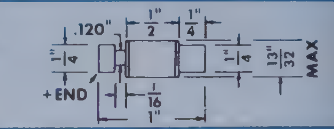
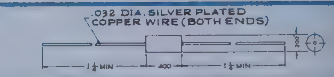
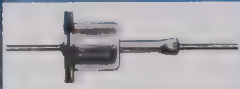
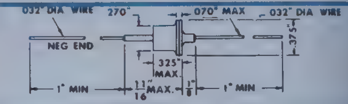
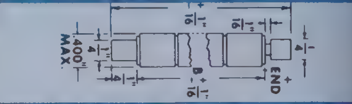
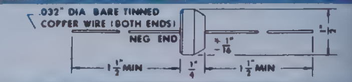
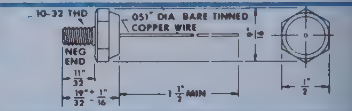
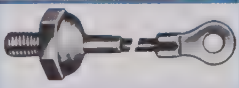
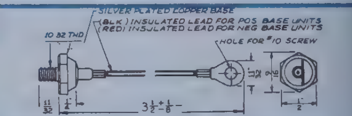
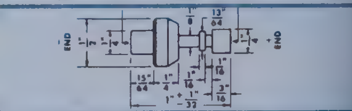
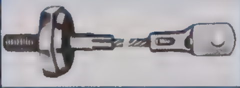
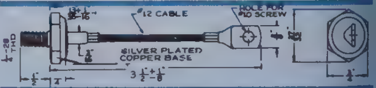
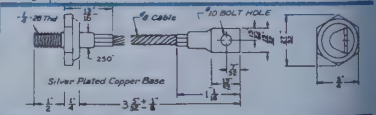
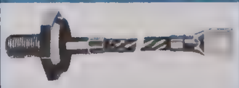
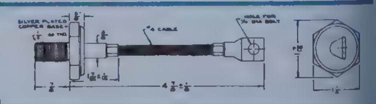
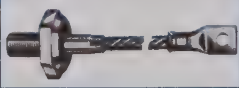
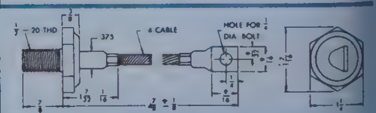
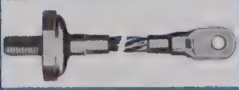
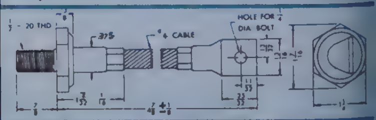
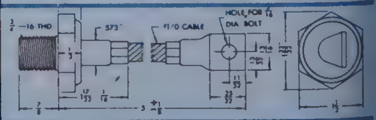
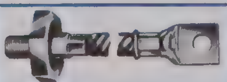
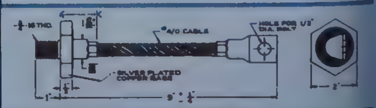
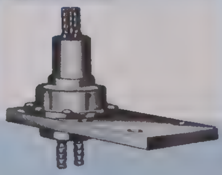
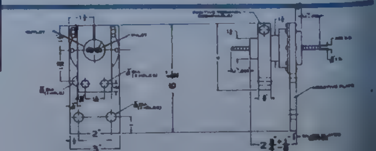
Listed below are silicon rectifiers representative of the Tarzian line. They are available in production quantities, at realistic prices, for both commercial and military applications.

Of particular importance in simplifying your power conversion circuitry assemblies are small size, high efficiency, mounting versatility and wide range of ratings offered by the Tarzian line.

In addition, the entire line features extremely low junction current density for maximum reliability and operating life. This is due to the special Tarzian alloy process with supported junction that produces the largest junctions available.

Altogether, the qualities and availability of the units cataloged here are invitations to invention in circuit design. Application engineering service is also available without obligation. Call the Sarkes Tarzian representative near you, or write Sarkes Tarzian, Inc., for complete catalog information.

SILICON RECTIFIERS

	amps. DC (100°C)		peak inverse voltage	max. RMS volts	Max. amps.		Tarzian Type	Jedec No.	Tarzian Type	Jedec No.	dimensions
					recurrent peak	surge 4MS					
Typical LOW CURRENT units	0.5		200	140	5	30	20M	1N1082			
			400	280	5	30	40M	1N1084			
			600	420	5	30	60M	—			
	0.5		200	140	5	75	F-2	1N2482			
			400	280	5	75	F-4	1N2483			
			600	420	5	75	F-6	1N2484			
	0.5		200	140	5	75	20H	1N2485			
			400	280	5	75	40H	1N2487			
			600	420	5	75	60H	1N2489			
	0.45		800	560	4.5	27	80SM	1N1108			
	0.4		1600	1120	4	24	160SM	1N1110			
	0.35		2400	1680	3.5	21	240SM	1N1112			
	0.325		2800	1960	3.25	19.5	280SM	1N1113			
Typical MEDIUM CURRENT units	1.5		200	140	10	100	20J1	1N1618			
			400	280	10	100	40J1	1N1620			
			600	420	10	100	60J1	—			
	10		200	140	50	150	20J2	1N1622			
			400	280	50	150	40J2	1N1624			
			600	420	50	150	60J2	—			
	12		200	140	72	150	20J3	—			
			400	280	72	150	40J3	—			
			600	420	72	150	60J3	—			
	2		200	140	30	100	20LA	1N1086			
			400	280	30	100	40LA	1N1088			
			600	420	30	100	60LA	—			
							NEGATIVE		POSITIVE		
Typical HEAVY CURRENT units	20		200	140	120	200	20R3N		20R3P		
			400	280	120	200	40R3N		40R3P		
			600	420	120	200	60R3N		60R3P		
	35		200	140	210	350	20S3N	—	20S3P	—	
			400	280	210	350	40S3N	—	40S3P	—	
			600	420	210	350	60S3N	—	60S3P	—	
	50		200	140	300	500	20T3N	—	20T3P	—	
			400	280	300	500	40T3N	—	40T3P	—	
			600	420	300	500	60T3N	—	60T3P	—	
	100		200	140	600	1000	20V3N	—	20V3P	—	
			400	280	600	1000	40V3N	—	40V3P	—	
			600	420	600	1000	60V3N	—	60V3P	—	
	150		200	140	900	1500	20W3N	—	20W3P	—	
			400	280	900	1500	40W3N	—	40W3P		
			600	420	900	1500	60W3N	—	60W3P		
	250		200	140	1500	2500	20Y3N	—	20Y3P		
			400	280	1500	2500	40Y3N	—	40Y3P		
			600	420	1500	2500	60Y3N	—	60Y3P		
	350		200	140	2100	3500	20G3N	—			
	1000		200	140	6000	10000	20ZB	—			

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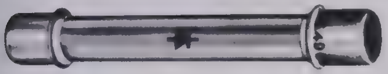
HIGH VOLTAGE SILICON CARTRIDGE RECTIFIERS

Each of the two series of Tarzian Silicon Cartridge Rectifiers shown below includes 18 different types with operating temperatures ranging from —55°C to 150°C ambient. Both the ferrule mounted series and the axial lead series feature low voltage drop and low reverse current. Tarzian High Voltage Cartridges are manufactured to meet standard Jedec classifications.

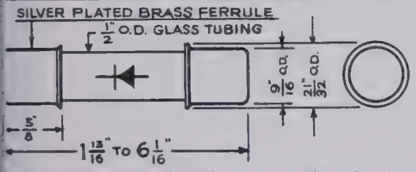
FERRULE MOUNTED SERIES—This high voltage series is equipped with a ferrule type mounting of silver plated brass and is available in both hermetically sealed glass or phenolic tubing in voltages ranging from 1000 to 10,000 peak inverse volts.

AXIAL LEAD SERIES—This high voltage series is available in units ranging in size from ½″ to 2½″ and lead lengths varying from 1″ to 2½″. Peak inverse voltage ratings are available from 1500 to 16,000 volts.



FERRULE MOUNTED SERIES

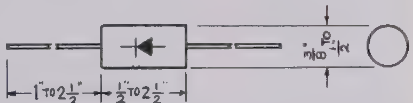
Operating Temperature Range —55°C to 150°C Ambient		Max. Ratings Half Wave Res. Load at 75°C Ambient	
Jedec Type	Sarkes Tarzian Type	Peak Inverse Volts	Max. Rectified DC Output MA
1N1133	S-5490	1500	75
1N1140	S-5497	3600	65
1N1143A	S-5501	6000	65
1N1146	S-5504	8000	45
1N1148	S-5506	14000	50
1N1149	S-5507	16000	45



When ordering phenolic tubing as a substitute for glass tubing, add the letter "P" to S.T. Type No.

AXIAL LEAD SERIES

Operating Temperature Range —55°C to 150°C Ambient					
Jedec Type	S.T. Type	Peak Inverse Volts	Max. RMS Input Volts*	Max. Rect. DC Output (MA) 25°C	100°C
1N1730	S-5518	1000	700	200	100
1N1731	S-5519	1500	1050	200	100
1N1734	S-5522	5000	3500	100	50
1N2375	S-5525	1500	1050	200	100
1N2379	S-5529	4000	2800	100	50
1N2385	S-5535	10000	7000	70	55

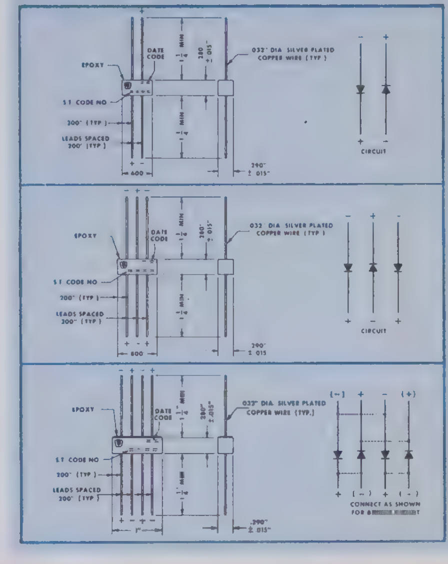


*Derate 50% for capacitive load in half wave circuits. For capacitive, motor, or battery loads, derate DC current by 20%.

MODULAR SILICON RECTIFIERS

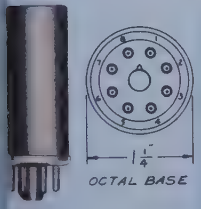
Modular Silicon Rectifiers can be used individually—as open bridges—or in a variety of circuit combinations, and are designed for printed circuits on terminal strips. Each of the units illustrated and tabulated below is only one of a series of six in the 18-unit Tarzian line.

Tarzian Code Number	Individual Diode Current Rating	Circuit Connections	Piv
S-5541	500MA	Center tap, Doubler	600
S-5549	500MA	3 phase Half Wave	600
S-5467	500MA	Bridge	600

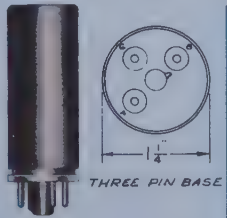


TUBE REPLACEMENT SILICON RECTIFIERS

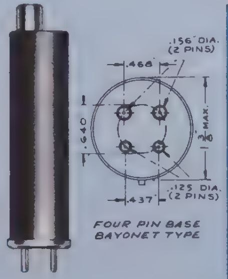
arzian tube replacement rectifiers, in addition to being directly nterchangeable with over 95% of all popular vacuum tube rectiers, are smaller, more compact, and carry dc current ratings as uch as three times as great as the tubes they replace. They have roved highly satisfactory in applications requiring high efficiency, long life, rugged construction and wide temperature ranges. Tarzian solid state rectifiers are available in ten standard models, with special designs and modifications on request. Special tube replacement units designed by Tarzian engineers include special designs with peak inverse voltages to 19,000 volts.



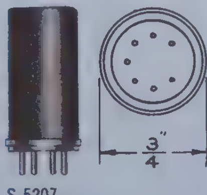
-5018
n Connection
n #8 (Cathode)
n #4 and #6 (Anode)
eplacement for types
U4, 5AW4, 5AZ4, 5T4,
U4, 5V4, 5W4, 5Y3, 5Z4,
31, 6087, 6106.



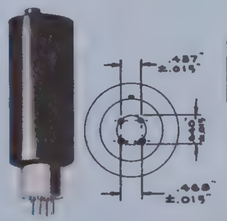
S-5019
Pin Connection
Pin #8 (Cathode)
Pin #6 and #4 (Anode)
Replacement for 5R4



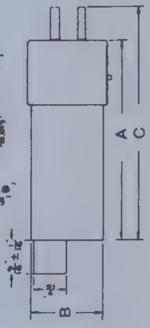
S-5130
Pin No. 1 is Pos.
Replacement for 866, 866A, 3B28



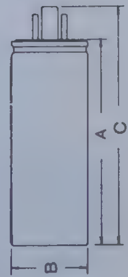
S-5207
Pin Connection
Pins #1 and #6 are A.C. (Anode)
Pin #7 is Pos. (Cathode)
Replacement for 6X4, 6063, 6202.



S-5367
Pin No. 1 is Pos.
Replacement for GL-8020 at reduced voltage

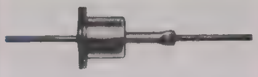


arzian Type	JEDEC Number	Max. Peak Inverse Voltage	Max. RMS Voltage	Max. Peak Current (ma)	Max. DC Current (ma)	Circuit	Type Load	Max. Ambient Temp.	Dimension "A" (inches)	Dimension "B" (inches)	Dimension "C" (inches)
S-5018	1N-1238	1,600	1,100	8,000	750	F.W.	Any	100°C	2 21/32	1¼	3 7/32
S-5019	1N-1239	2,800	1,950	5,000	500	F.W.	Any	100°C	3¾	1⅜	4 5/16
S-5130	—	10,400	*7,400	3,000	300	H.W.	Res.-Ind.	100°C	4 7/16	1 7/32	8⅛
S-5207	1N-2490	1,600	1,100	5,000	500	F.W.	Any	100°C	1½	13/16	1¾
S-5367	—	19,000	13,400	2,500	250	H.W.	Res.-Ind.	100°C	6	2 1/16	6 19/32



or capacitive loads derate input voltage 50%, and current 20%.

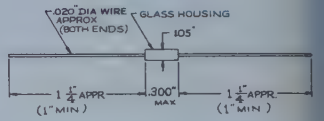
SARKES TARZIAN SILICON VOLTAGE REGULATORS

 ¼ WATT REGULATORS Specifications 25°C.					 **1 WATT REGULATORS** Specifications 25°C.				 **10 WATT REGULATORS** Specifications 25°C.				
Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Jedec Type	Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Tarzian Type	Zener Volt. (V)	Test Cur. (Ma)	Dyn. Imp. (Ohms)	Jedec Type
.25T5.6	5.6	25	3.6	1N708	1T5.6	5.6	100	1.2	10T5.6	5.6	1000	1	1N1803
.25T6.2	6.2	25	4.1	1N709	1T6.2	6.2	100	1.5	10T6.2	6.2	1000	1	1N1804
.25T6.8	6.8	25	4.7	1N710	1T6.8	6.8	100	1.7	10T6.8	6.8	1000	1	1N1805
.25T7.5	7.5	25	5.3	1N711	1T7.5	7.5	100	2.1	10T7.5	7.5	1000	1	1N1806
.25T8.2	8.2	25	6.0	1N712	1T8.2	8.2	100	2.4	10T8.2	8.2	1000	1	1N1807
.25T9.1	9.1	12	7.0	1N713	1T9.1	9.1	50	3.0	10T9.1	9.1	500	1	1N1808
.25T10	10	12	8.0	1N714	1T10	10	50	3.5	10T10	10	500	2	1N1351
.25T11	11	12	9.0	1N715	1T11	11	50	4.2	10T11	11	500	2	1N1352
.25T12	12	12	10	1N716	1T12	12	50	5.0	10T12	12	500	2	1N1353
.25T13	13	12	11	1N717	1T13	13	50	5.8	10T13	13	500	2	1N1354
.25T15	15	12	13	1N718	1T15	15	50	7.6	10T15	15	500	2	1N1355
.25T16	16	12	15	1N719	1T16	16	50	8.6	10T16	16	500	3	1N1356
.25T18	18	12	17	1N720	1T18	18	50	11	10T18	18	150	3	1N1357
.25T20	20	4	20	1N721	1T20	20	15	13	10T20	20	150	3	1N1358
.25T22	22	4	24	1N722	1T22	22	15	16	10T22	22	150	3	1N1359
.25T24	24	4	28	1N723	1T24	24	15	18	10T24	24	150	3	1N1360
.25T27	27	4	35	1N724	1T27	27	15	23	10T27	27	150	3	1N1361
.25T30	30	4	42	1N725	1T30	30	15	28	10T30	30	150	4	1N1362
.25T33	33	4	50	1N726	1T33	33	15	33	10T33	33	150	4	1N1363
.25T36	36	4	60	1N727	1T36	36	15	39	10T36	36	150	5	1N1364
.25T39	39	4	70	1N728	1T39	39	15	45	10T39	39	150	5	1N1365
.25T43	43	4	84	1N729	1T43	43	15	54	10T43	43	150	6	1N1366
.25T47	47	4	98	1N730	1T47	47	15	64	10T47	47	150	7	1N1367
.25T51	51	4	115	1N731	1T51	51	15	74	10T51	51	150	8	1N1368
.25T56	56	4	140	1N732	1T56	56	15	88	10T56	56	150	9	1N1369
.25T62	62	2	170	1N733	1T62	62	5	105	10T62	62	50	12	1N1370
.25T68	68	2	200	1N734	1T68	68	5	125	10T68	68	50	14	1N1371
.25T75	75	2	240	1N735	1T75	75	5	150	10T75	75	50	20	1N1372
.25T82	82	2	280	1N736	1T82	82	5	175	10T82	82	50	22	1N1373
.25T91	91	1	340	1N737	1T91	91	5	220	10T91	91	50	35	1N1374
.25T100	100	1	400	1N738	1T100	100	5	260	10T100	100	50	40	1N1375

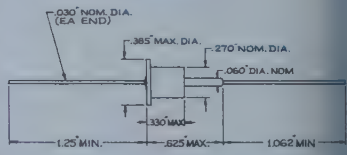
NOTES: Standard tolerance is ± 10% however, closer or wider tolerances are available on request.
Also available on request: (a) Special voltage ratings. (b) Symmetrical double anode types (for clippers).

The full line of constant voltage devices tabulated here are used to control output voltage of power sources and as voltage reference elements capable of operating over a wide temperature range. Hermetic sealing and mechanical ruggedness provide long term reliability even under the most adverse conditions. These three power classifications cover a wide range of applications. The regulators also are available in production quantities. Call your nearest Tarzian representative for application assistance.

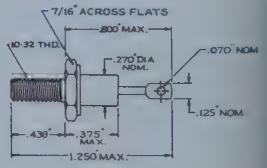
¼ WATT



1 WATT



10 WATT



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An 8-Fold Improvement In Stereo Controls

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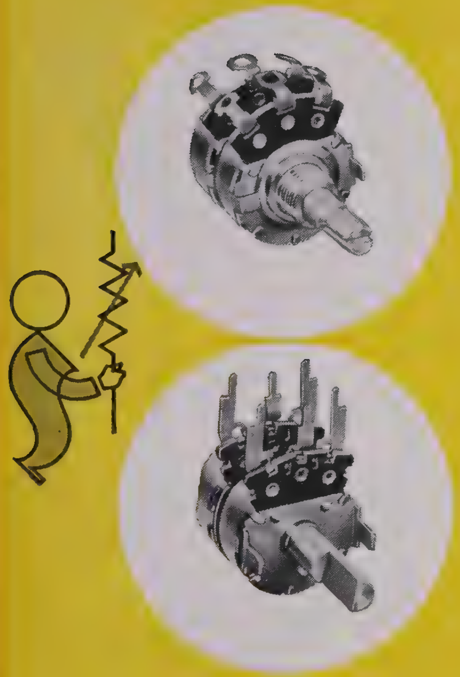

Here's the kind of variable resistor performance that pays off in greater circuit design freedom . . . in continued customer satisfaction. Thanks to their new high stability SURETRAK* elements, these new Stackpole single-shaft dual controls stay within initially close tolerances throughout years of use or disuse — and with minimum derating.

To learn more about this basic advance in variable resistors for stereo, ask your local Stackpole sales engineer about Type LST (bushing mount) or Type LST-T (twist-tab mount), or write: Electronic Components Div., Stackpole Carbon Co., St. Marys, Pa.

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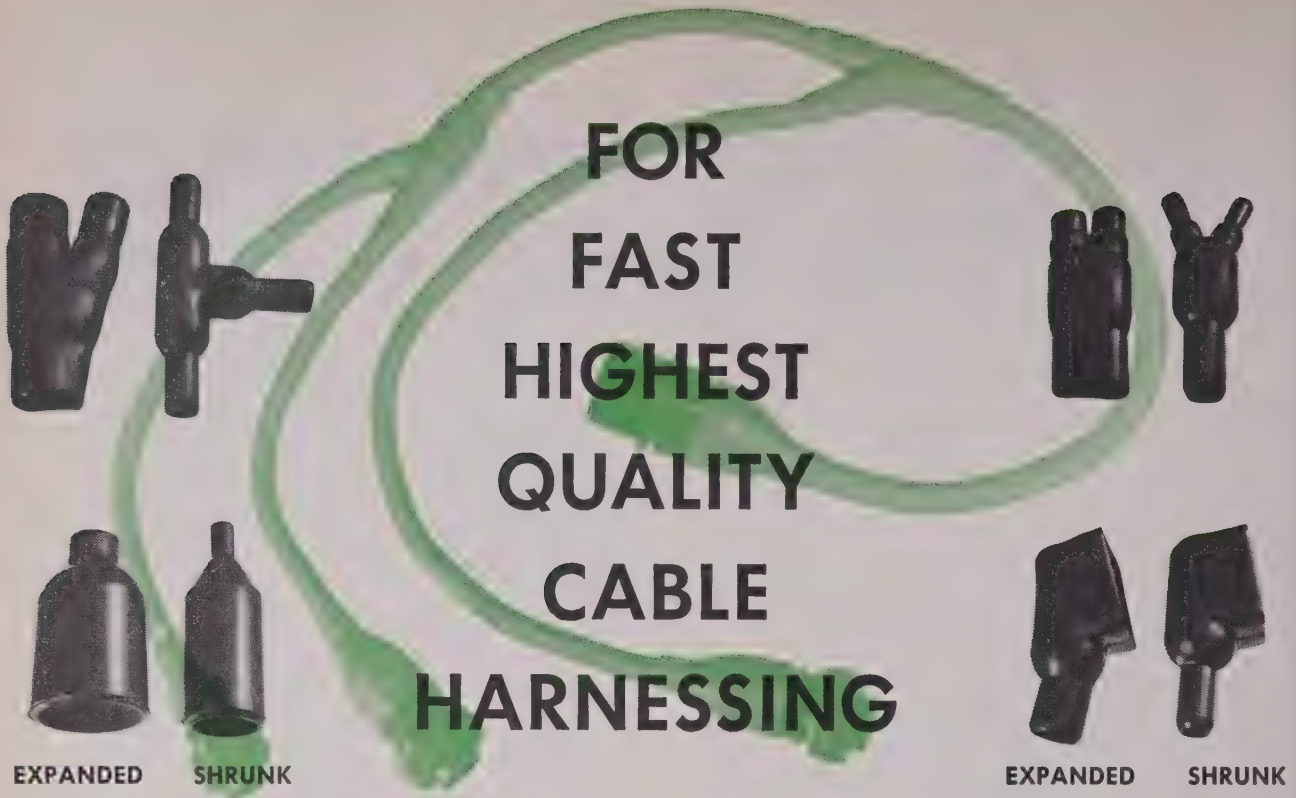
STACKPOLE VARIABLE composition RESISTORS

COLDITE 70+® FIXED COMPOSITION RESISTORS • SLIDE AND SNAP SWITCHES • CERAMAG® FERRITE CORES • FIXED COMPOSITION CAPACITORS • CERAMAGNET® CERAMIC MAGNETS • BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT ELECTRICAL CONTACTS • GRAPHITE BEARINGS, SEAL RINGS, ANODES • HUNDREDS OF RELATED CARBON AND GRAPHITE PRODUCTS



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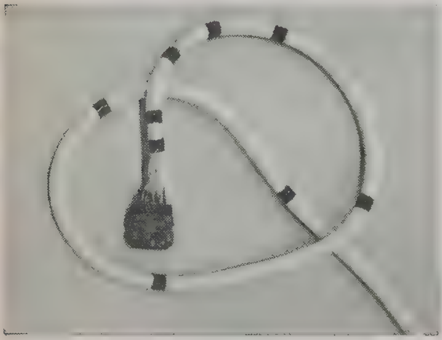
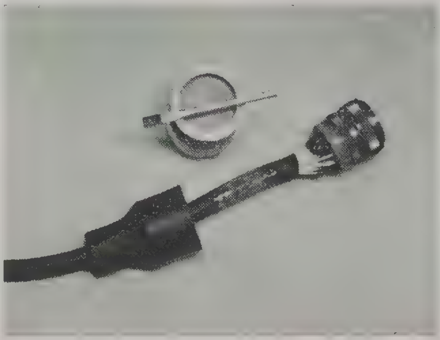


THE CABLE



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News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

AEROVOX CORP., New Bedford, Mass., announces a 2-year warranty now in effect on Aerovox capacitors and resistors sold through all industry markets.

SPERRY GYROSCOPE CO., Great Neck, N. Y., has received 3 contracts totaling $13.7 million and **SPERRY PIEDMONT CO.**, Charlottesville, Va., has received a $2.7 million contract for shipboard radar and underwater detection systems for the U. S. Navy.

INTERNATIONAL RESISTANCE CO.'s BOONE DIV., is building a 10,000 sq. ft. extension to its Boone, N. C. plant.

RCA's AEROSPACE COMMUNICATIONS & CONTROL DIV., Defense Electronic Products, Burlington, Mass., has received a $423,967 contract from the U. S. Air Force, Rome Air Development Center, Rome, N. Y., to design and study the feasibility of a simulation testing facility under the DOD RF Compatibility Program.

RAYTHEON CO., Lexington, Mass., has been awarded a $7,008,165 contract to conduct a feasibility study of a new concept for ballistic missile defense called ARPAT.

SYLVANIA ELECTRIC PRODUCTS INC., Woburn, Mass., has released plans for expanding its Semiconductor Div. manufacturing facilities by more than 40%. Plans include a 14,000 sq. ft. addition at Woburn to be completed in October; a 50,000 sq. ft. addition at Woburn to be completed by spring of 1962 and a 17,000 sq. ft. addition at its Hillsboro, N. H. plant completed in mid-August.

FENWAL ELECTRONICS, INC., has moved to 63 Fountain St., Framingham, Mass.

PHILCO CORP., Lansdale, Pa., has been awarded $162,141 production engineering measure contract from the U. S. Army Signal Supply Agency, Phila., Pa., to develop automatic production equipment for the manufacture of silicon surface alloy transistors (SAT) for military end use.

The Board of Directors of **LABORATORY FOR ELECTRONICS, INC.**, and **TRACERLAB, INC.**, have voted to merge the two companies. LFE would be the surviving company.

VITRO CORP. OF AMERICA, New York, N. Y., has been awarded a $7,450,000 contract by the Air Force Systems Command for operation, maintenance and engineering of the Eglin Gulf Test Range, Florida.

CALIFORNIA EASTERN AVIATION, INC., Washington, D. C., has changed its company name to **DYNALECTRON CORP.**

REFLECTONE ELECTRONICS, INC., a sub. of Universal Match Corp., Stamford, Conn., has received contracts from the U. S. Air Force totalling $11,881,000 for electronic mission training systems, T3-T4 Electronic Countermeasures (ECM) Simulators. The systems will be used at SAC bases throughout the U. S.

GENERAL INSTRUMENT CORP., has established a Ferro-Electric Ceramic Dept. at its Newark, N. J. headquarters.

AIRCRAFT ARMAMENTS, INC., Cokeysville, Md., has received an award contract for $2,588,133 from the U. S. Army Ordnance District, Phila., Pa. for production of training equipment for the U. S. Army's Sergeant Missile System.

ARMA DIV., AMERICAN BOSCH ARMA CORP., Garden City, N. Y., has received a U. S. Navy contract totaling almost $400,000 for the manufacture of 50 shipboard compasses.

C. P. CLARE & CO., has begun construction of an addition to it's Fairview, N. C. plant, which will add 25% to the present facilities.

MICROWAVE ASSOCIATES, INC., has received contracts for research and development totalling over $330,000 from the departments of the U. S. Army, Navy and Air Force. Contracts cover the field of high-power duplexers, microwave plasma amplifiers and microwave semiconductor devices.

MIDWEST

DALE ELECTRONICS, INC., Columbus, Nebr., announces that the production of Dale Trimmer Potentiometers, formerly handled in Burbank, Calif., has been transferred to the main plant at Columbus.

OAK MFG. CO., Crystal Lake, Ill., has formally dedicated its new 206,000 sq. ft. general office and manufacturing plant. The facility contains executive offices, engineering and principal manufacturing operations and costs $3 million.

COLLINS RADIO CO., CEDAR RAPIDS DIV., has completed a 124,000 sq. ft. addition. The construction cost is approximately $1,800,000.

EATON MFG. CO., Southfield, Mich., has officially opened it's $1,300,000 Research Center.

COLUMBIA WIRE & SUPPLY CO., Chicago, Ill., has completed negotiations with Racine Specialty Mfg. Co., Racine, Wis., including all rights for the manufacture and sale of the new Cord-N'-Reel with built-in outlets.

ROHN MFG. CO., Peoria, Ill., has purchased the assets of Alprodco, Inc., Memphis, Tenn.

MIDWEST RESEARCH INSTITUTE, Kansas City, Mo., has organized a center for the study of developments in germanium technology and for the encouragement of germanium research. The center is to be known as the Germanium Information center.

CTS CORP., Elkhart, Ind., has been awarded a $238,767 contract from the U. S. Army Signal Corps for the production engineering measure for subminiature, transistor type potentiometers.

MAGNECRAFT ELECTRIC CO., Chicago, Ill., has started construction on a 185,000 sq. ft. plant for the design, development and manufacture of electromagnetic relays, on the northwest side of Chicago.

WESTINGHOUSE ELECTRIC CORP., Lima, Ohio, has received a $50,000 study contract awarded by the Aeronautical Systems Div. of the U. S. A. F. Systems Command for a 4,000 w solar power system suitable for use in earth orbiting satellites.

WEST

MOTOROLA SEMICONDUCTOR PRODUCTS DIV., Phoenix, Ariz., has received an Air Force Aeronautical Systems Div. contract for $1,473,094 for a study of compatible techniques for integrated circuit functions.

SHOCKLEY TRANSISTOR, Unit of Clevite Transistor, has moved into its new 2-story 37,000 sq. ft. building at 1801 Page Mill Rd., Stanford Industrial Park, Palo Alto, Calif.

ALPHA WIRE CORP. has expanded its Pacific Div. to a complete factory warehouse and sales operation. It has moved its facilities to a larger building at 11844 Mississippi Ave., Los Angeles, Calif.

CONSOLIDATED ELECTRODYNAMICS CORP., Pasadena, Calif., announces it is integrating its Datalab Div. into the Data Recorders Div. and Consolidated Systems Corp.

HOFFMAN ELECTRONICS CORP., MILITARY PRODUCTS DIV., Los Angeles, Calif., has received a contract in excess of $3 million for the delivery of 964 AN/ARN-21C TACAN systems to the U. S. Air Force.

GENERAL ELECTRIC CO., Los Angeles, Calif., has opened a new Palo Alto facility at 701 Welch Rd., combining the Defense Field Operations, Semiconductor and Ordnance Depts. and Receiving Tube office.

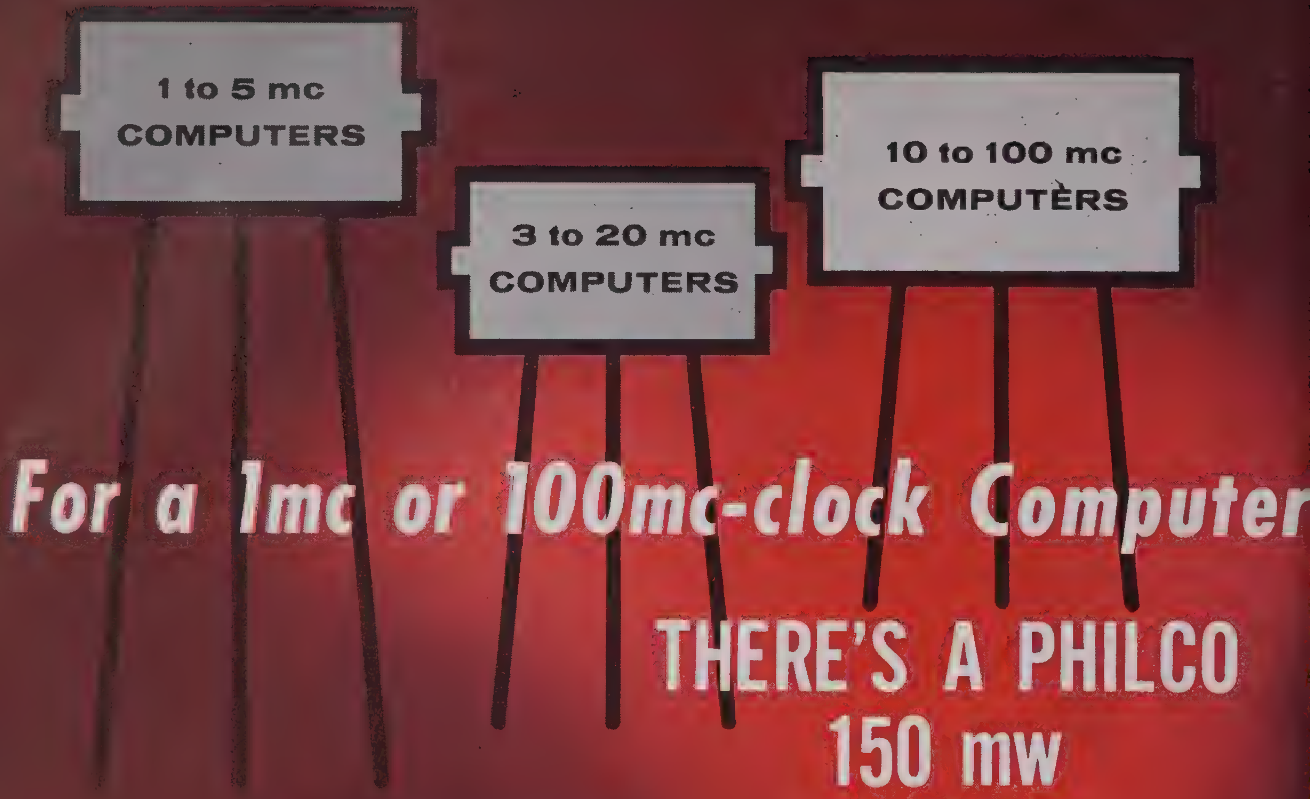
NON-LINEAR SYSTEMS, INC., Del Mar, Calif., has opened regional factory offices in Palo Alto, Calif. and Boston, Mass.

GENERAL ELECTRIC CO.'s COMPUTER LABORATORY, Sunnyvale, Calif., is constructing a 39,000 sq. ft. facility to be completed the end of this year. Occupancy is scheduled for early next year.

U. S. ENGINEERING CO., div. of Litton Industries, Van Nuys, Calif., has completed building additions totalling 4,000 sq. ft.

LING-TEMCO-VOUGHT, INC., the merging name of Ling-Temco Electronics, Inc., and Chance Vought Corp., became effective as of Aug. 31, 1961. The agreement provides for transfer of CV assets and properties to L-T in exchange for convertible debentures and stock purchase warrants.

SPACE ELECTRONICS CORP., Glendale, Calif., is developing a new PCM telemetry system for satellites under a $93,000 contract from NASA.



For a 1mc or 100mc-clock Computer

THERE'S A PHILCO 150 mw MADT*®

Seven important circuit advantages, inherent in every Philco MADT, are:

1. **Tight Parameter Control;**
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3. **Exceedingly Low V (SAT);**
4. **Very Low Collector Capacitance;**
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7. **Industry's Best-Documented Reliability.**

Four new Philco 150 mw *Micro-Alloy Diffused-base Transistors bring even more versatility to industry's most reliable transistor line. Now, you can benefit from MADT proven product advantages in a broader-than-ever range of applications, including those that require high power dissipation. In addition to an expanding line of 150 mw types, there's the *new ultra-high-speed 100 mw MADT type 2N976—the world's fastest switch.* There's an MADT that gives you optimum cost efficiency for your specific requirements.

For complete information on these high power dissipation MADT's, and application assistance on any transistor circuit, write Dept. EI961.

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MADT's are
immediately available
in quantities 1-999
from your Philco
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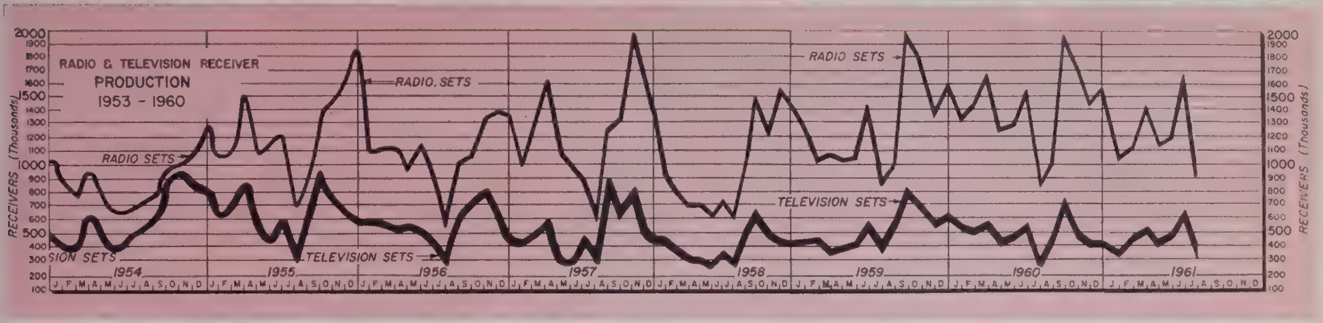
Facts and Figures Round-Up
September 1961

ELECTRONIC INDUSTRIES TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in July, 1961.

Accelerometers	55,038
Amplifiers	110,072
Antenna	5,855,505
Batteries	3,661,441
Beacons, Radio & Radar	215,525
Cable	69,548
Cable, RF	447,632
Cable, telephone	1,006,635
Calibrator	966,612
Capacitor	28,432
Chamber, cable terminal	88,052
Chest Set	259,350
Coder/Decoder	7,795,577
Coils	45,017
Communication equipment	367,828
Computer Planner	1,060,000
Computers	443,218
Connectors & Adapters	150,000
Consoles	390,112
Control Group	654,748
Converters	115,063
Coordinate Data Set	967,400
Data Plotter, Electronic	79,900
DF Equipment	533,740
Duplicator, Magnetic Tape	98,413
Filters	86,588
Gyros	973,549
Handset, headset	720,231
IFF Equipment	58,725
Indicators	2,311,433
Intercom Set	195,681
Key Generator, Data	306,996
Loudspeaker	57,713
Measuring Set, Visibility	292,050
Meters	1,621,665
Microanalyzer, Electron Probe	59,630
Microphones	422,367
Multiplex	295,215
Oscillators	287,293
Oscilloscope	1,309,643
Power Supplies	791,420
Radar	12,263,292
Radiac Set	131,595
Radiameter	322,903
Radio Set	16,699,532
Radiosonde Sets	209,195
Receivers	2,983,824
Recorders	376,878
Recorder/Reproducer	240,635
Relay	131,109
Relay Armatures	114,601
Repeater, Telegraph	312,775
Reproducer, Sound	41,923
Resistors	92,547
Resolvers	423,103
Semiconductor Device Set	30,326
Semiconductors	423,000
Servos	799,763
Signal Generators	699,068
Sonar	2,600,465
Sounding Equipment	156,923
Spectrometer	266,927
Spectrum Analyzer	687,327
Stabilization Equipment	300,000
Switch Assys	99,850
Switchboard	1,482,413
Systems	3,206,835
Tape, Recording Magnetic	782,083
Telemetry Equipment	2,514,796
Telephone Equipment	2,373,737
Teletype Equip	4,662,637
Terminal Telephone	3,126,922
Test Equipment	2,037,607
Test Sets	2,216,562
Timers	29,172
Towers	399,355
Trainers	1,949,657
Transceiver	82,328
Transducers	240,580
Transmitters	3,054,415
Transponders	27,424
Tropospheric Scatter Equipment	1,500,000
Tubes, Electron	538,192
TV Equipment	680,083
X-Ray Equipment	229,914

Estimated Shipments of Semiconductors, during 1960[1]

CATEGORY	QUANTITY (in thousands of units)			VALUE (in thousands of dollars)		
	Total	Military	Nonmilitary	Total	Military	Nonmilitary
SEMICONDUCTOR DEVICES	329,392	93,687	235,705	541,948	258,161	283,787
Diodes, rect. and related devices	197,570	70,180	127,390	228,021	114,081	113,940
Germanium diodes and rect.	97,472	31,756	65,716	49,071	22,363	26,708
0–30 ma	53,274	16,069	37,205	24,846	11,387	13,459
31–100 ma	36,319	12,893	23,426	18,428	9,052	9,376
Over 100 ma	7,879	2,794	5,085	5,797	1,924	3,873
Silicon diodes and rect.	81,195	33,651	47,544	129,240	68,523	60,717
0–30 ma	14,695	8,899	5,796	23,456	16,397	7,059
31–100 ma	16,957	9,509	7,448	29,910	19,031	10,879
101–550 ma	25,509	8,388	17,121	32,795	15,394	17,401
551 ma– 3 a	16,612	5,629	10,983	21,233	9,090	12,143
Over 3 a–35 a	6,905	1,016	5,889	13,755	4,744	9,011
Over 35 a	517	210	307	8,091	3,867	4,224
Zener diodes	6,400	2,768	3,632	27,227	11,789	15,438
Microwave diodes	1,122	1,122	(1)	5,125	5,125	(1)
Infra-red and other semiconductor photo cells, except solar cells	321	95	226	2,693	1,776	917
Other [2]	11,060	788	10,272	14,665	4,505	10,160
Transistors	131,822	23,507	108,315	313,927	144,080	169,847
Germanium	121,274	16,263	105,011	207,247	65,360	141,887
0–125 mw	44,761	8,354	36,407	73,620	29,417	44,203
126–999 mw	60,484	6,186	54,298	95,194	24,643	70,551
1 w and over	16,029	1,723	14,306	38,433	11,300	27,133
Silicon	10,548	7,244	3,304	106,680	78,720	27,960

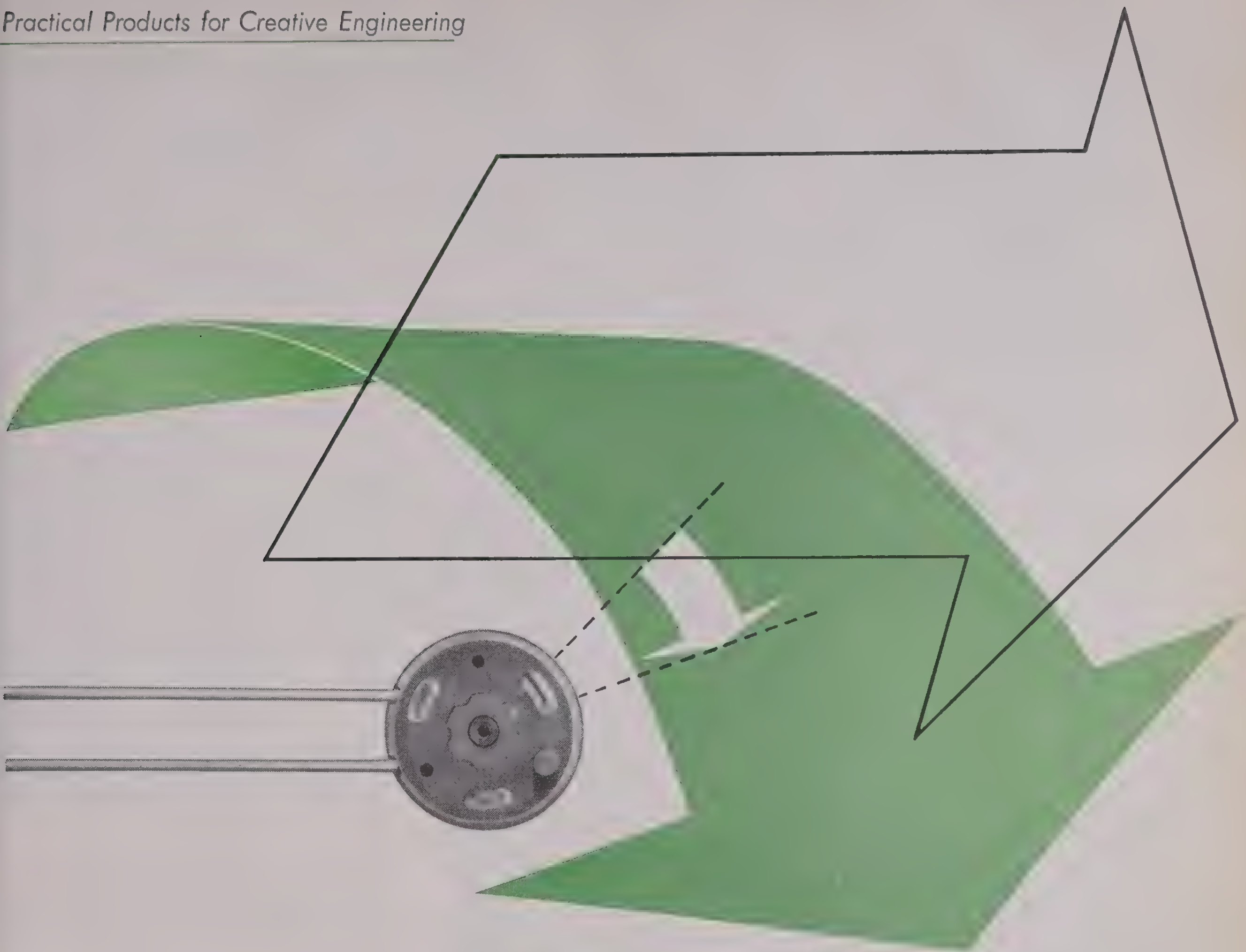
[1] Nonmilitary shipments of microwave diodes were combined with military shipments to avoid disclosure of proprietary information.
[2] Includes diodes and rectifiers made from materials other than silicon and germanium, tunnel diodes, controlled rectifiers, solar cells, and other special semiconductor devices which must be combined to avoid disclosure of proprietary information.

Source: Quarterly Joint Survey of Production Capabilities for Electronic Parts conducted by the Electronics Production Resources Agency of the Department of Defense, and the Electronics Division, BDSA.

***Shockley* TRANSISTOR unit of CLEVITE TRANSISTOR** tests random samples of each day's production of type E diodes* at 100,000 G's. Mil-Specs normally call for just 20,000 G's. The extra G's prove that Shockley 4-layer diodes go far beyond the stresses they would encounter in any application. These tough, fast-switching 4-layer diodes are used in arming and squib firing circuits, alarm systems, high energy pulse circuits, memory circuits, relay driving circuits, logic matrices for airborne and portable radar, sonar, proximity fuses, encoders and decoders, communications equipment, missiles . . . Stanford Industrial Park, Palo Alto, California. **type E diode: the new Shockley 4-layer, subminiature glass diode.*

Circle 13 on Inquiry Card

Practical Products for Creative Engineering



PUT POWERFUL "DOWNHILL" TORQUE INTO YOUR REMOTE ACTUATION

OAK ROTARY SOLENOIDS provide high torque at the start of their actuation stroke—where and when it's needed most. Ordinarily, magnetic attraction of the solenoid coil is greatest near the end of the stroke. This problem has been solved by inclining the ball races at a steeper angle near the top—or start—of the race. This "downhill" action levels off near the end of the rotary stroke. Since torque is inversely proportional to the length of stroke, a 2E solenoid that provides 6.4 inch-ounces of starting torque at 45° would offer almost twice as much torque when designed for a 25° stroke. You can obtain Oak Solenoids for stepping angles of 25°, 35°, 45°, and 67.5°—in right—or left-hand rotation. Because Oak Solenoids are custom-made to meet specific actuation and torque requirements, you can outline your needs with your local Oak sales representative. If you prefer, send a sketch of your design to our Applications Engineering department.

Creative Engineering • Quality Components

OAK MANUFACTURING CO.
CRYSTAL LAKE, ILLINOIS • *telephone: Crystal Lake, 459-5000*
OAK ELECTRONICS CORPORATION, *(Subsidiary) Culver City, California*

ROTARY AND PUSHBUTTON SWITCHES • TELEVISION AND FM TUNERS • SUBASSEMBLIES
APPLIANCE CONTROLS • CHOPPERS • ROTARY SOLENOIDS • VIBRATORS

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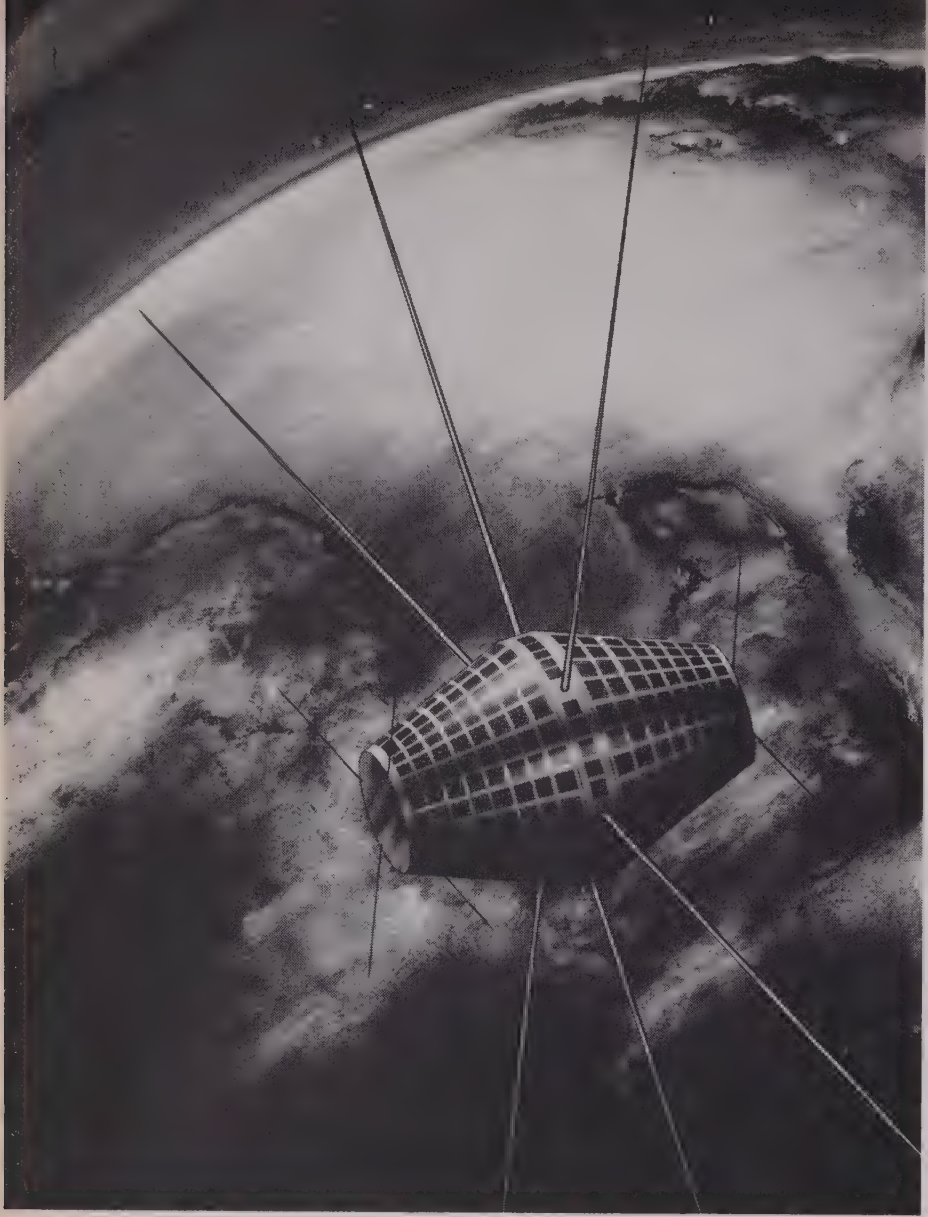
Snapshots . .



BOUNCING EGG

An egg embedded in a flexible silicone compound developed by General Electric makes an unbreakable bouncing toy for this child (right). Compound was developed to protect delicate electronic components in missiles and space vehicles from shock and vibration. Known as LTV-602 clear potting compound, material is poured around whole pieces of electronic circuitry and allowed to set up to a flexible solid, protecting the equipment.

TOPSIDE SOUNDER SATELLITE

Artist's rendering of the Topside Sounder satellite in orbit (left). Expected to be launched in 1962 by a Scout rocket, it will be designed and built by Airborne Instruments Laboratory, Deer Park, L.I., N.Y., and the central Radio Propagation Laboratory of the National Bureau of Standards for NASA. Once orbited, the satellite will measure the electron density of the ionosphere above the peak ionization of the F_2 layer, roughly 200 miles above the earth.

SOLAR POWER PANEL

Solar power converter panel built for the JPL Ranger RA-1 Space Probe is given final check-out in laboratory. Panel will provide about 90 watts of continuous electrical power and contains 4340 individual silicon solar cells. Built by the Semiconductor Div. of Hoffman Electronics Corp., it weighs 19 lbs.

AUTOMATED TUBE TESTER

Conveyorized Automatic Tube Tester (CATT), developed and built by National Video Corp., Chicago, Ill. can test 11 cathode ray tubes per minute. Observing the CATT in operation are (l to r), D. Giachetti, NVC vice president, D. Plack, chief physicist and director of research, and A. J. Cole, NVC president.

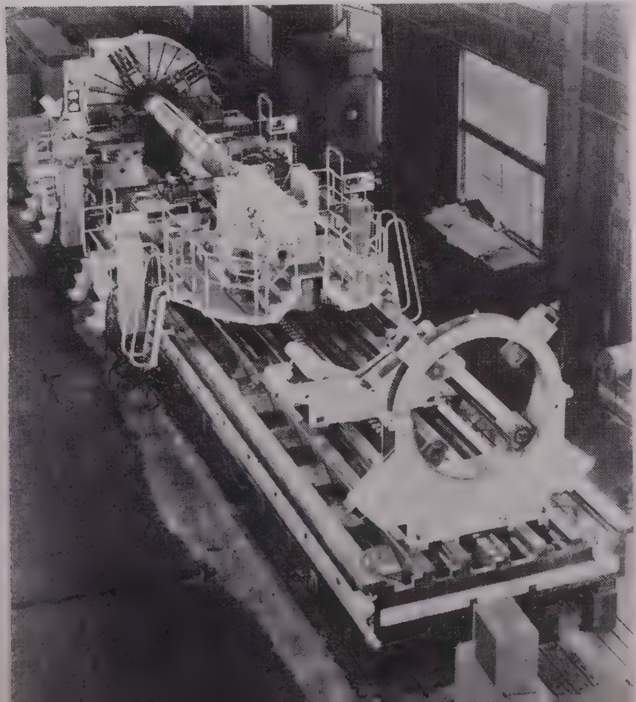
GIANT RECTIFIER

Giant rectifier rated at 35,000 volts dc at 55 amperes is made by International Rectifier Corp., El Segundo, Calif. Each column contains 360 separate rectifier cells. Devices like these are needed in radar systems and to help science learn more about energy from nuclear fusion in linear accelerometers.

# of the Electronic Industries

ELECTRONICALLY-CONTROLLED LATHE

Designed and built by Baldwin-Hamilton Corp., Eddystone, Pa., giant lathe is shown undergoing final checks before shipment to Bethlehem Steel, Bethlehem, Pa. Lathe bed is equipped with two front and two rear carriages with pushbutton, electronic-feed-and-traverse controls.



AGAVE ANTENNA

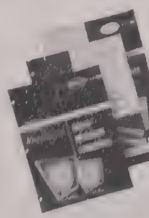
AGAVE antenna at Kano, Nigeria is part of NASA's globe-girdling system of tracking stations which will keep a guiding "eye" on the first U.S. Astronaut to go into orbit. Project Mercury sites around the world will use the antennas made by Cubic Corp., San Diego, Calif.

BUILT FOR ROUGH DUTY IN TIGHT SPACES

MODEL MM5-22 SCREWLOCK CONNECTOR
SHOWN ACTUAL SIZE

Continental's Series 22 Micro-Miniature Connectors are designed expressly for jobs that demand the ultimate in miniaturization without sacrifice of performance. Their ruggedness is service-proven daily in hundreds of aircraft, missile, computer and other applications where severe shock and vibration are normal environments.

Series 22 Connectors are available in a range of 14 sizes, providing 5 to 104 contacts, to meet virtually every requirement for high density connection in minimum space. All feature glass-filled Diallyl Phthalate moldings, self-aligning phosphor bronze contacts, gold plated over silver, and can be supplied with beryllium contacts on order. Reversed guide pins and sockets assure positive polarization, and all sizes are available with screwlocks, protective shells and hoods.



DESIGNERS' DATA FILE

To help you select the micro-miniature connector that best meets your design requirements, Continental's Con-Dex File MM provides complete electrical, mechanical and dimensional data on the Series 22 Micro-Miniature Connectors. Write for your copy to: **Electronic Sales Division, DeJur-Amsco Corporation, Northern Boulevard at 45th St., Long Island City 1, New York (Exclusive Sales Agent) RAvenswood 1-8000.**

MICRO-MINIATURE • SUB-MINIATURE • MINIATURE • PRINTED CIRCUIT • RIGHT ANGLE PIN & SOCKET • CENTER SCREWLOCK

CONTINENTAL CONNECTORS

CONTINENTAL CONNECTOR CORPORATION • WOODSIDE 77, NEW YORK

Circle 15 on Inquiry Card

Where even a fingerprint can cause trouble, **ultrasonic cleaning** makes the crucial difference...

and in ultrasonic cleaners—

GENESOLV® D **FLUOROCARBON SOLVENT**

can make the clean difference!

Ultrasonic cleaning is only as good as the solvent you use! In critical precision guidance and electronic components, foreign matter 1/40th the diameter of a human hair can cause malfunction. Fingerprints, water marks, specks of dust, lint, epidermis and many other contaminants are potential trouble makers. Your ultrasonic cleaning material must itself be super clean . . . and effective against a wide range of contaminants, while non-injurious to the parent material.

GENESOLV D Fluorocarbon Solvent offers the exceptional purity you need . . . plus these other specific advantages in ultrasonic cleaning operations:

- ✓ *extremely low undissolved and dissolved residue*
- ✓ *selectivity*
- ✓ *low toxicity*
- ✓ *nonflammability*
- ✓ *low surface tension (increased wettability, with minimum dragout)*
- ✓ *quick drying*

Find out now about GENESOLV D's special effectiveness. Our Technical Service constantly is developing new data, and would be pleased to work with you on your cleaning problems. Write or phone your nearest General Chemical Office.

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Circle 16 on Inquiry Card

EI's International News

PUERTO RICO

Electronics Boom In Puerto Rico

The Puerto Rico Economic Development Administration announced that sixteen U. S. electronics companies were among the 190 U. S. and Puerto Rican firms who signed up for new "Operation Bootstrap" factories in the Caribbean Commonwealth during fiscal 1960-61.

The new electronics ventures include General Electric, Daystrom, Cannon Electric, Interstate Engineering, Specialty Electronics Development Corp., Electrosolids Corp., Electrospace Corp., National Video Corp., Video Instruments Co. and General Electronic Control Inc.

Products they will produce in Puerto Rico include instruments, mercury buttons, fire alarms, circuit breakers, portable two way radios, resistors, electron guns for cathode ray TV tubes, transformers, terminals, and radio frequency coaxial connectors.

The rapid growth of hard goods manufacturing in the Caribbean Commonwealth has resulted in a record shipment of $8,829,000 of electronics products to the mainland in 1960, an increase of 89 percent over the previous year.

Since 1956, annual shipments of U. S. appliance and electronics plants from the Commonwealth to the mainland have more than doubled to $62,000,000 while metal working factories tripled volume in the same period to $15,000,000.

GHANA

First Trade Show In West Africa

The first U. S. Trade Exhibition held in any of the West African republics will be staged at Accra, Ghana, next November, Secretary of Commerce, Luther H. Hodges announced today.

Secretary Hodges said: "Our Exhibition will be a practical, working, do-it-yourself demonstration of American techniques and equipment which other new countries have found helpful in achieving their goals of economic and social progress.

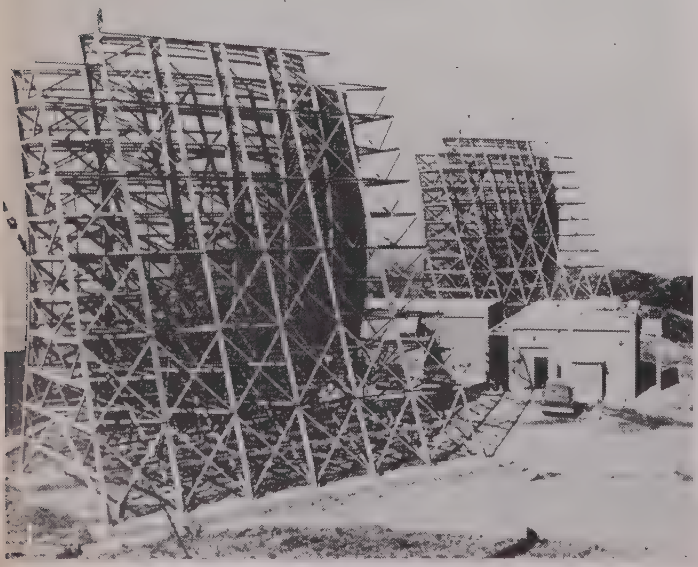
"Under the theme 'Small Industries Are Big Business,' the Exhibition is designed to illustrate the real interest of the U. S. Government in assisting the Republic of Ghana to develop its industry by providing both visual and manual examples of what can be done by using basic tools and production techniques."

In addition to many industrial training projects to be demonstrated a training school will provide a 30-day course in communications and audio-visual training aids, covering assembly, operation and maintenance.

The latest methods in education training will be demonstrated in a schoolroom set up for teaching elementary grades.

Other exhibits designed to interest everyone from industrialists and businessmen to white collar workers and farmers will include business machines, agricultural and road-building machinery, and commercial canning equipment.

WORLD'S LONGEST FPTS SYSTEM



Two of the four Blaw-Knox antennas linking Formosa and Okinawa uses the world's longest Forward Propagation Tropospheric Scatter System. The 60-foot parabolic reflectors are anchored to 50-foot deep concrete footers.

PRESIDENT OF EAC

James Hurst has been named president of the newly-established EAC International, European subsidiary of Electronic Assistance Corporation of Red Bank, N. J. With headquarters in Lugano, Switzerland, the new firm will cross license the manufacture of EAC military products to Western European firms serving NATO countries.

IRAQ

All New System For Iraqi Communications

A contract to the value of approximately $300,000 has been signed by the Iraqi Port Authority and Pye Telecommunications Limited of England for the supply and installation of a v.h.f. and u.h.f. radiotelephone network for services at Margil for Basrah Airport; the Ports' Ambulance; Fire-fighting Units; Electricity Distribution Department and the Maritime Services. Several other services in this area are also being installed.

It is anticipated that the entire scheme will be fully operational early in 1962 and will be one of the most modern in the whole of the Middle East.

NORWAY

Remote Control TV Constructed on Island

The Norwegian Telegraph Administration is building a television station on the island of Bokn in Stavenger Fiord and is to operate it by remote control from the mainland by means of a VHF radio link.

The transmitters selected for this purpose—two 4 kw vision and two 1 kw sound—are of Marconi manufacture, and are suitable for unattended operation. In addition to the transmitters, Marconi's are to supply and install programme input and ancillary equipment.

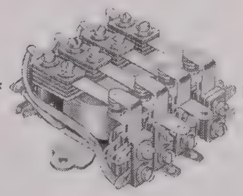
(*Continued on page* 36)

4-POLE POWER CONTROL RELAYS FROM STOCK

Elgin Advance stocks the only 4-pole power control relay of this type on the market. Specify the PC Series when you require dependable current switching.

The PC Series features heavy load carrying capacity, combined with small size—a variety of contact arrangements—and a wide range of AC and DC coil voltages and resistances.

another example of



reliable relayability

SPECIFICATIONS

Contact arrangements—SPDT, DPDT, 3PDT, 4PDT
Contact rating—15 amps resistive, 5 amps inductive
Contact material—0.25″ dia fine silver
Coil voltages & resistances—wide range of AC and DC
AC power—10-12 VA, nominal
DC power—2-3 watts, nominal
Dimensions—1.906″ x 3.062″ x 2.593″, maximum
Weight—8 ounces, maximum

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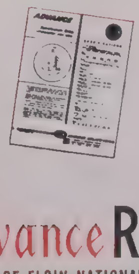
send for



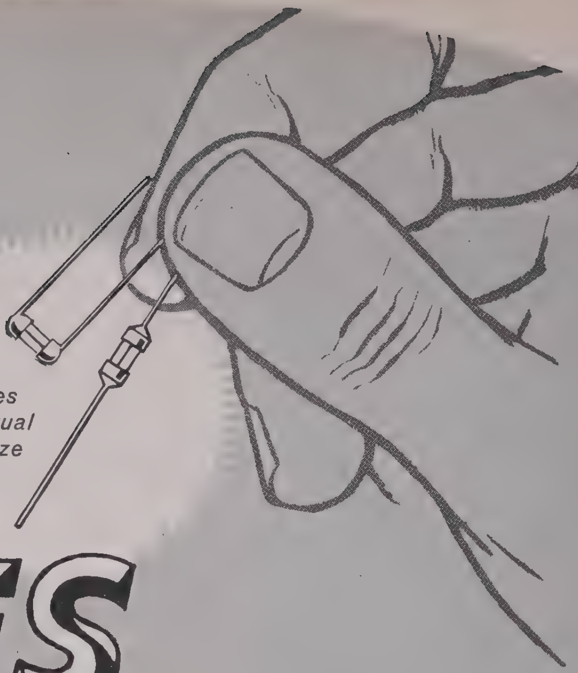
latest data

ELGIN advance RELAYS
THE ELECTRONICS DIVISION OF ELGIN NATIONAL WATCH COMPANY
2435 NORTH NAOMI STREET, BURBANK, CALIFORNIA

Circle 17 on Inquiry Card

Another outstanding development by the Makers of BUSS fuses

TRON FUSES


Fuses actual size

Sub-miniatures — hermetically sealed   *Body size only .140 x .300 inches*

For Use Where Space is at a Premium

Tron fuses are so small they can easily be used as an integral part of circuit – to protect miniaturized devices – or gigantic multi-circuit electronic devices – without sacrifice of space.

Fuse elements hermetically sealed. Tron fuses may be potted or encapsulated without danger of sealing material affecting operation. They are not affected by atmospheric conditions. They are designed for installation in high shock and vibration ambients.

They are self-protecting and operate without exterior flash or venting, so they can be installed anywhere in the circuit. Likewise, they may be teamed in one capsule or replaceable unit with such components as resistors or condensers.

Available in ratings from 1/20 to 5 amps. for use on circuits of 125 volts or less where available fault current is not over 50 amps. Color coding indicates ampere rating and assists in final inspection of fused circuits.

Made with Axial pigtails that are adapted to feed through automatic wire forming machines — or with right angle pigtails conveniently spaced for assembly on printed circuit chassis.

Get the full story: —
Write for BUSS Bulletin TRON

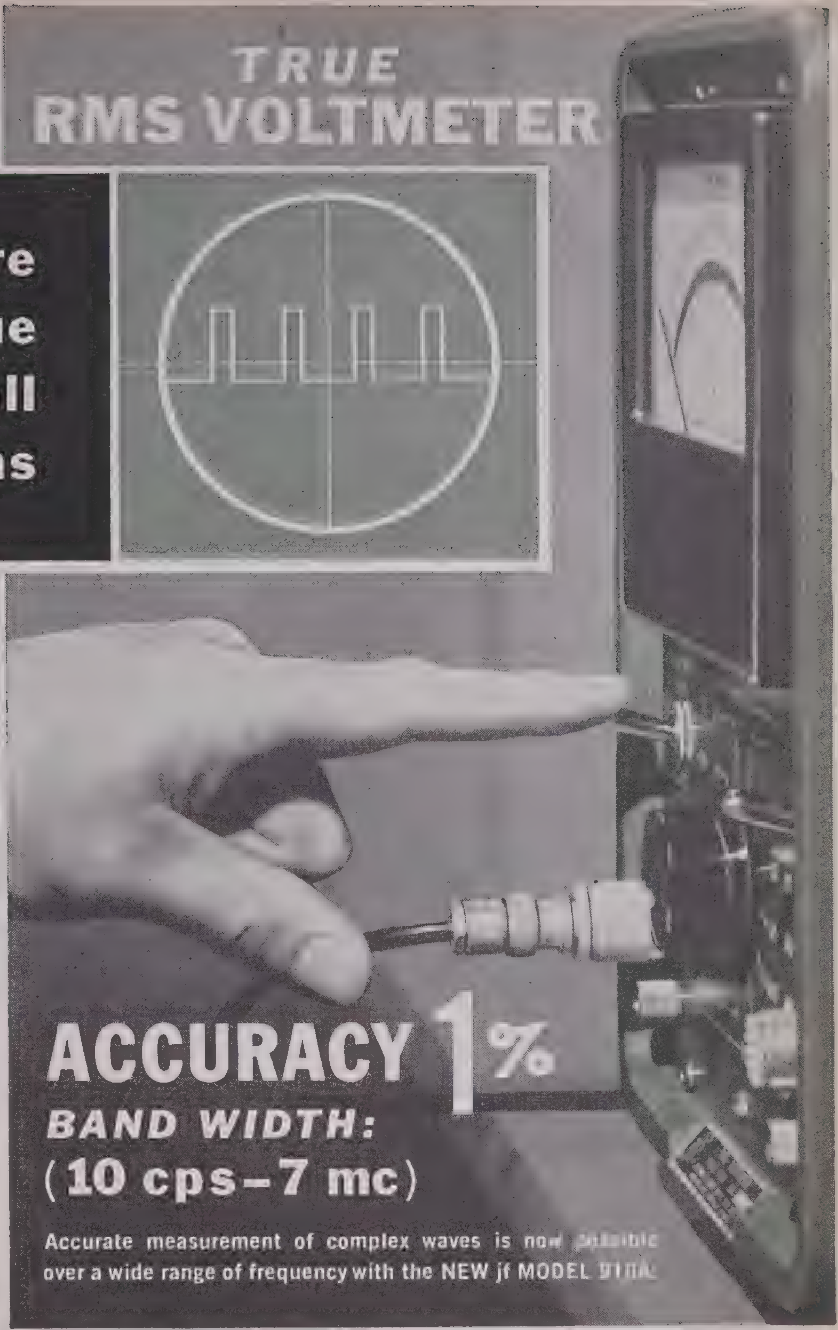
In the BUSS line,
you'll find the type and size fuse to fit your every need . . . plus a companion line of clips, blocks and holders.

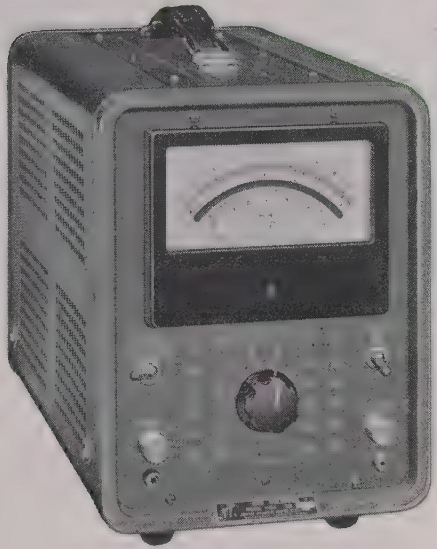
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
McGRAW EDISON

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.,*
UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.

ALL-NEW... TRUE RMS VOLTMETER

now . . . measure true RMS value of virtually all waveforms


ACCURACY 1%
BAND WIDTH:
(10 cps–7 mc)
Accurate measurement of complex waves is now possible over a wide range of frequency with the NEW jf MODEL 910A.



MODEL 910A

For the *first time* one instrument provides 1% midband accuracy, 10 cps to 7mc bandwidth, plus 100 u v sensitivity. For added versatility an amplifier output is provided for simultaneous oscilloscope or recorder monitoring.

Model 910A employs a thermocouple located in the feedback loop of a sensitive DC amplifier to measure the actual heating effect of the input waveform. This circuit arrangement is the key to the rapid response and high calibration accuracy of the Model 910A and also prevents any error in reading due to ambient temperature variation. Isolation of the thermocouple from the input terminals by a high gain, ultra stable AC amplifier provides high input impedance and completely protects the thermocouple from burnout under any condition of overload.

Model 910A is ideal for measuring AC currents in non linear devices, total harmonic content of distorted waveforms, noise, average power of pulse trains, and other measurements that involve waveforms which are not necessarily pure sinusoids.

Partial Specifications—jf MODEL 910A

Voltage Range:	1 MV to 300V (full scale readings)
Decibel Range:	—72 to +52 dbm
Frequency Response:	10 cps to 7Mc
Accuracy:	± 1% of full scale 50 cps to 800 KC ± 2% of full scale 20 cps to 2Mc ± 3% of full scale 20 cps to 3.5 Mc ± 5% of full scale 10 cps to 7 Mc
Input Impedance:	10 megohms shunted by 30 pf for 0.3 volt range and below. 10 megohms shunted by 15 pf for 1.0 volt range and above.
Crest Factor:	3 at full scale, proportionately higher for readings less than full scale.
Price:	Cabinet Model—$545.00 Rack Model—$565.00 Prices f.o.b. factory.

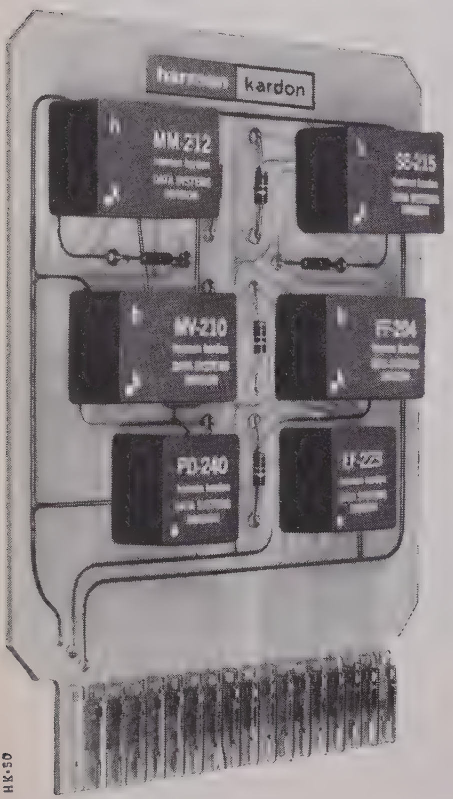
Prices and data subject to change without notice.

A more complete description will be sent to you upon request.

JOHN FLUKE MFG. CO., INC.
P. O. Box 7428 Seattle 33, Washington

Circle 19 on Inquiry Card

2 new H-K Logic Module Series to choose from



125°C.•5 MC... Plus a new economical packaging advance... Harman-Kardon

Flexi-Card

Here's two way flexibility... to provide the exact encapsulated digital logic assembly you need, at substantial savings:

1. Three compatible H-K module series...**125°C.• 5 MC.• 250 KC.**

2. *Flexi-Card*—the new circuit card assembly that lets you specify the exact circuit assortment needed—delivered quickly and economically by Harman-Kardon.

No need to pay for more flip-flops, gates, drivers...than you need. Harman-Kardon's new approach to card assemblies provides custom utility at stock prices. Get the facts on this doubly good news! Write for details on the expanded range of encapsulated digital logic modules... and *Flexi-Card*—Harman-Kardon's new versatile circuit card assembly.

D→ S→ D→ →H-K

Data Systems Division

harman kardon

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FREE
HANDY POCKET GUIDE TO BOOLEAN ALGEBRA!
Send for your copy today!

International News

(*Continued from page* 32)

SWITZERLAND

European Computer Association Founded

Announcement is made of the establishment of the European Computer Manufacturers Association (ECMA) with headquarters and secretariat in Geneva.

Members of the Association are companies which in Europe develop, manufacture and market data processing machines designed to process information for business, engineering, scientific and other similar purposes.

The object of the Association is to further the adoption of data processing standards for the benefit of users, the public and the industry itself. Its primary purpose in cooperation with national and international standards organizations, is to secure inter-company cooperation which will enable European manufacturers to offer better products at less cost.

Four technical committees are already at work to study and develop standards in the area of: Flowcharting, Programming Languages, Character sets and code representation, and Character recognition.

CANADA

IBM Installation is Biggest in Canada

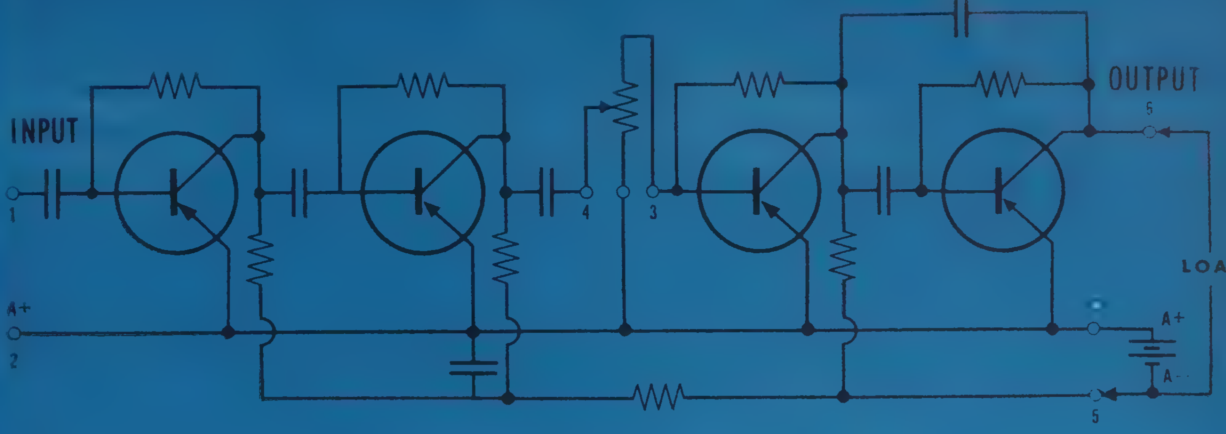
The largest capacity 1401 IBM data processing system currently in industrial use in Canada is now in operation in Massey-Ferguson's North American Operations Unit headquarters in Toronto.

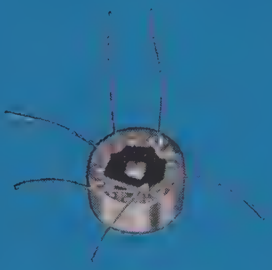
The huge computing capacity of the new 1401 IBM equipment can handle the weekly payroll of 3,500 employees in the Toronto factory in two hours instead of the 5,250 man-hours of clerical work formerly required.

The equipment offers the potential to process a wide range of data associated with overall marketing, financial, engineering, and manufacturing requirements, according to Mr. Fred Anderson, general administrative services manager for North America. Much of the type of information now being processed has been done in the past by other equipment, the new installation offers us vastly increased flexibility and speed of processing data.

Among the first visitors to the installation were delegates to the recent conference in Toronto of the National Machine Accountants Association. Some 70 delegates from Canada, the United States, and overseas toured the installation as guests of the company.

* * *

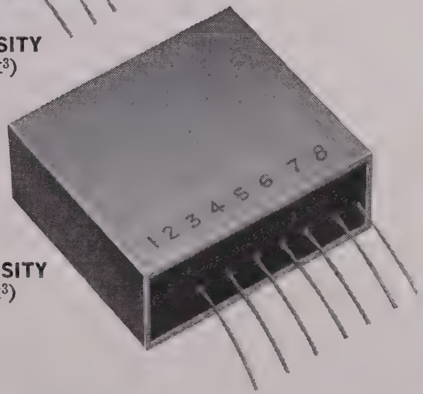




ACTUAL SIZE
.228″ high, .531 diam.
COMPONENT DENSITY
324/in³ (560,000/ft³)

PEC* miniaturized transistor amplifiers are production units at Centralab

1⅛″ x ⅝″ x ¼″
COMPONENT DENSITY
120/in³ (208,000/ft³)



1⁷⁄₁₆″ x 1⅛″ x ¹⁹⁄₃₂″
COMPONENT DENSITY
19.8/in³ (34,200/ft³)

*trade mark

Laboratory curiosities? Absolutely not! These miniature amplifiers are available NOW as standard production units, at realistic prices.

Use them confidently in dozens of applications, in audio, instrumentation, and specialty products. They permit practical circuit miniaturization in your current projects, thanks to the CENTRALAB PEC technique that achieves component densities as high as 2,500,000 per cubic foot.

These units range in output from 0.5 mw. to 3 mw., and can be supplied with frequency curves to meet your specific requirements. For detailed specifications and application information, write to CENTRALAB and request Technical Bulletin 42-1018.

Centralab CRL ®

THE ELECTRONICS DIVISION OF GLOBE-UNION, INC.
938J E. KEEFE AVENUE • MILWAUKEE 1, WISCONSIN
CENTRALAB CANADA LTD • AJAX, ONTARIO

Y-6123

ELECTRONIC SWITCHES • VARIABLE RESISTORS • CERAMIC CAPACITORS • PACKAGED ELECTRONIC CIRCUITS • ENGINEERED CERAMICS

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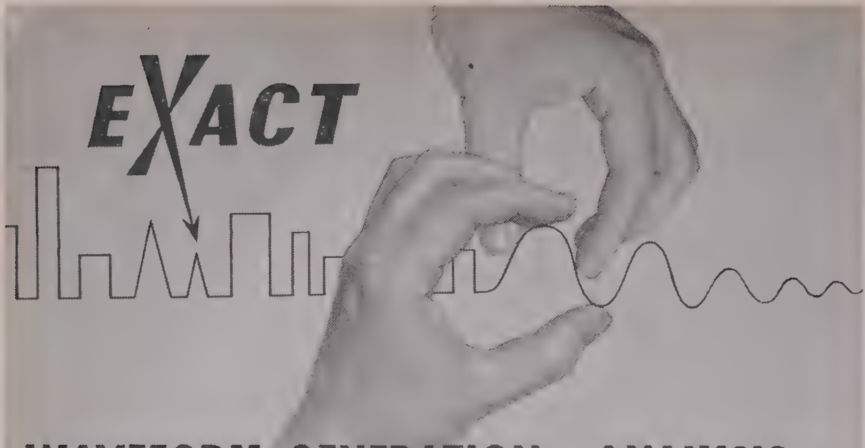


WAVEFORM GENERATION — ANALYSIS — CONTROL

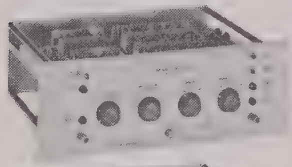
Type 200 Waveform Synthesizer

The Exact Waveform Synthesizer, with one or more of its three plug-in units, provides an ultra-flexible, precise laboratory tool for generation, simulation, control, study, and design of complex waveforms.

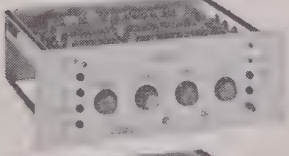
Widely variable parameters. Broad repetition rate. 50-volt amplitude output. External programming. The speed, reliability, and accuracy of hard tube circuitry. The versatility of 50 individually controlled pulse increments.

APPLICATIONS INCLUDE: Digital Pattern and Word Generation • Stairstep Generation • Shock, Vibration, Environmental Testing • Missile and Space Telemetry Simulation • Correctional Signal Generation • Cancelling Signal Generation • Guidance System Generator • Systems Tolerance Check-Out, etc.

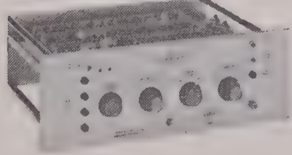
Type C Plug-In Variable Width



Type F Plug-In Variable Slope



Type E Plug-In 100-Increment Generator



EXACT electronics, inc.
P.O. Box 234 • Hillsboro, Oregon
CONTACT your Exact representative, below, for full information

Eastern Canada *Allan Crawford Assoc., Willowdale, Ont.*
Western Canada & Northwest *Comptronics, Seattle*
California *Tech-Ser Inc., Los Angeles, East Palo Alto, San Diego*
Arizona *Tech-Ser Inc., San Diego*
Mountain States *Hytronic Measurements Inc., Denver, Salt Lake City*
New Mexico *Hytronic Measurements, Inc., Albuquerque*
North Central *Bard Associates, Riverside, Ill.*
Ohio *The Satullo Co., Cleveland, Cincinnati*
Michigan *The Satullo Co., Royal Oak*
Western Pennsylvania *The Satullo Co., Pittsburgh*
New England *Technical Instruments Inc., Reading, Mass., Bridgeport, Conn.*
New York State *Martin P. Andrews Inc., Fayetteville*
Southern New Jersey & Eastern Pa. *C. E. Snow Co., Philadelphia*
Washington, D.C., Maryland, Virginia *C. E. Snow Co., Bethesda*

Receiver Pinpoints Astronaut Landing

The spot where an astronaut has landed in a space capsule after orbiting the earth can be pinpointed by a radio receiver developed by International Telephone and Telegraph Corp., Fort Wayne, Ind.

The receiver is used by patrol aircraft to pick up signals from a transmitter in the space capsule. Received signals are displayed as a spot of light on the face of a small "picture tube" on the receiver. The position of the light on the tube face indicates whether the patrol aircraft is on course and enables the pilot to "home in" on the signal.

The receiver is designed to receive CW signals, single pulse signals, and correlated double pulses. This results in greater safety for the astronaut. If one type of signal reception becomes inoperative, another may be used to locate the capsule.

Bank Uses Closed Circuit Television

Dual-headquarters of First National City Bank, N. Y., are separated by more than four miles of city streets. Despite this separation, the two have been bonded into a single operating unit through use of a closed circuit TV system (see picture) designed and built by General Precision Laboratories of Pleasantville, N. Y.

Dual headquarters of the First National City Bank, New York are welded into a single operating unit through use of this closed circuit television system.

Conference rooms of Uptown and Downtown offices each contain two 27 inch monitor type TV sets, microphones, and a special unit for televising documents under discussion. Control panels for monitoring and adjusting the signals are in separate areas. The visual signal is transmitted by coaxial cable leased from the N. Y. Telephone Co. Audio is transmitted over leased phone facilities also.

Circle 22 on Inquiry Card

STOP

eyeletting or thru-plating printed circuit boards!

Use AMP CIRCUITIP* Terminals

. . . AMP's tapered terminal, crimped to electronic component leads with precision-engineered, high-speed, automatic application machines.

CIRCUITIP Terminals give you quick, secure mounting of components at lowest installed costs anywhere.

ADDITIONAL FEATURES: • Mechanical retention of components prior to soldering • crimp configuration to aid capillary action of solder • standardization of hole size • bridging and offsetting of components for air circulation • heat sink in tip to help dissipate heat and protect costly components • uniform solder fillets • automatic trimming and bending of component leads • absence of radial wire protection ideal for increased board density. **Send for complete information today.**

*TRADEMARK OF AMP INC.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

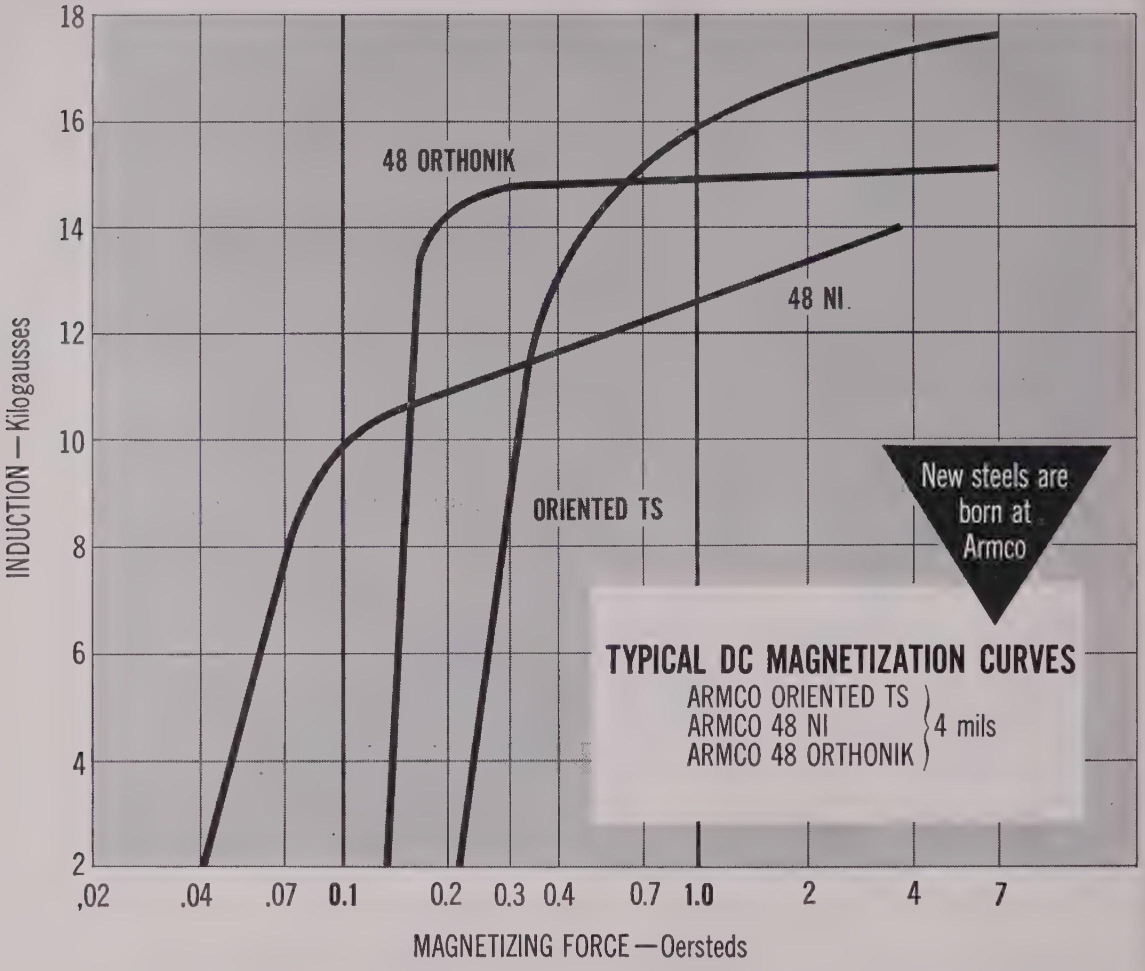
AMP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan • Mexico • West Germany

Circle 23 on Inquiry Card

Armco Magnetic Core Materials Give You Selectivity for Highest Efficiency, Lowest Cost

Electrical Steel

For better electrical apparatus



Armco Thin Electrical Steels and nickel-iron alloys, Armco 48 Ni and 48 ORTHONIK®, offer a wide range of magnetic properties, thicknesses and costs. They enable you to select core material for most effective and economical design of communications, computer, control and other high efficiency equipment.

Armco Thin Electrical Steels—Permit an advantageous balance of performance and cost for apparatus that operates at 400 cycles and higher, such as servos, magnetic amplifiers, motors and specialty transformers. Armco TRAN-COR® T is available in thicknesses of 5 and 7 mils; Oriented T in 1, 2 and 4 mils; and Oriented TS in 4 mils.

Armco 48 Ni—Especially useful for communications equipment and high quality transformers because of its high permeability at low and moderate inductions, low coercive force, and low hysteresis loss. Available in thicknesses of 2 to 14 mils and especially processed for wound cores or laminations.

Armco 48 ORTHONIK—Combination of a rectangular hysteresis loop and low coercive force makes cores of 48 ORTHONIK ideal for computers, reactors, magnetic amplifiers, and bi-stable elements for logic circuits. Available in thicknesses from ¼ to 14 mils for use over a wide range of frequencies.

Use the multiple advantages of these high performance Armco Magnetic Materials in your products. Detailed design data are available to help you use them most effectively. **Armco Division, Armco Steel Corporation, 2131 Curtis Street, Middletown, Ohio.**

ARMCO **Armco Division**

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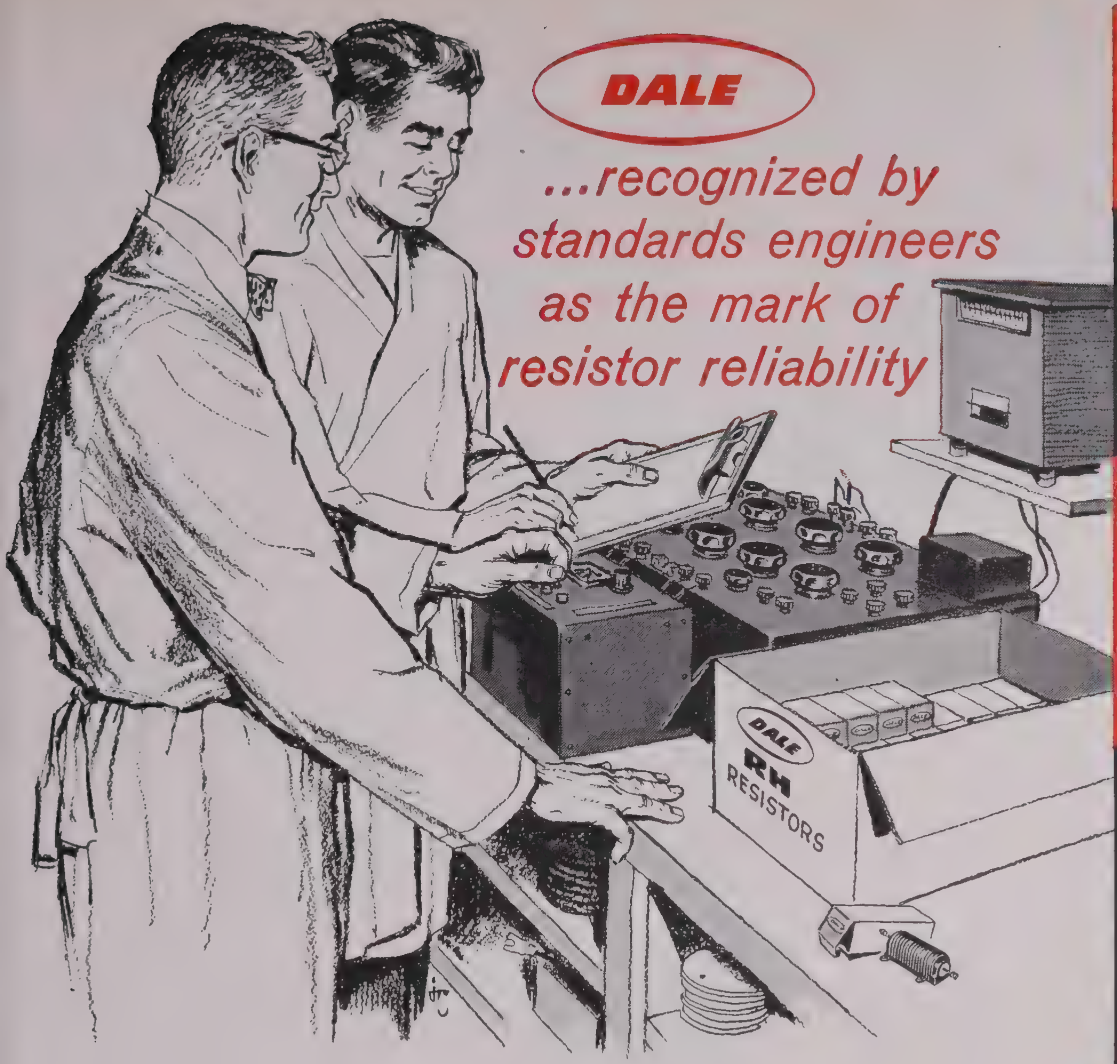
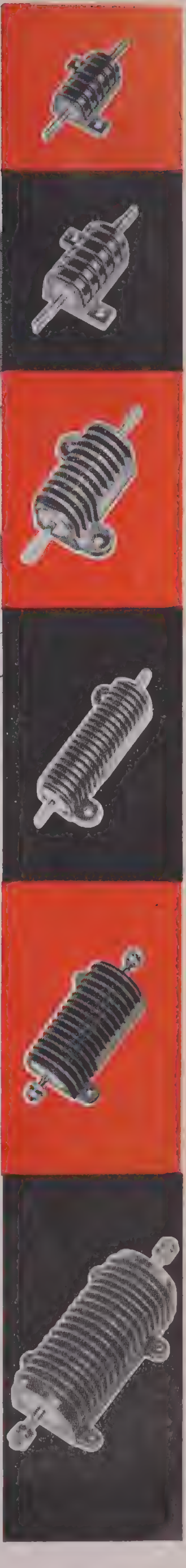


DALE

...recognized by standards engineers as the mark of resistor reliability



Each incoming inspection adds weight to the conviction already held by standards engineers: You can depend on Dale resistors for performance as specified.

Dale resistor reliability is the result of Dale's advanced design and stringently controlled methods of manufacture . . . methods which have reached new levels of achievement as part of Dale's super-high reliability development program.

SPECIAL PROBLEMS? Let us help you with your requirements for special resistance products. We make modifications of standard products, resistor networks, matched pairs, etc. Send us your specs.

PROMPT DELIVERY: Whether your need is for a short "test run" or a large production release, Dale offers prompt service, direct from the factory and through a widespread network of distributors.

Write for Bulletin R-21 with handy cross reference file card

Hathaway Instruments Inc.

DALE ELECTRONICS, INC.

1304 28th Ave., Columbus, Nebraska

A subsidiary of HATHAWAY INSTRUMENTS, INC.

DALE TYPE RH RESISTORS

WIRE WOUND • MINIATURE • HIGH POWER

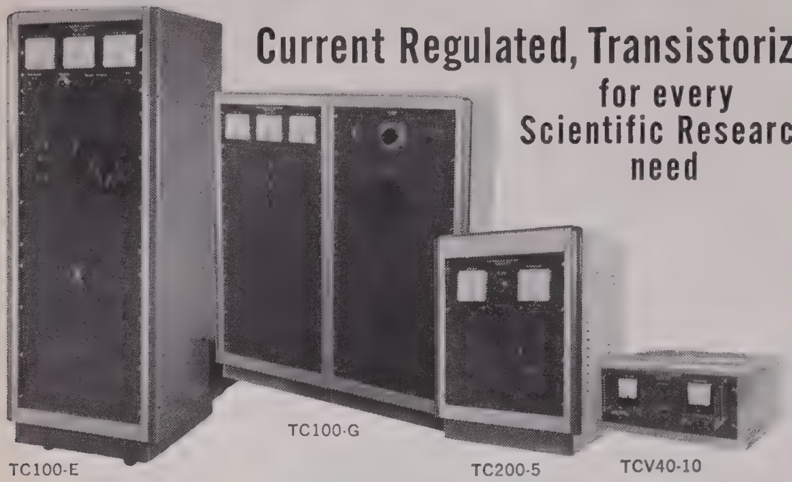
Designed primarily for application with high power requirements, coupled with precision tolerance. Mount on chassis for maximum heat dissipation. Operate under severe environmental conditions, offering complete protection from salt spray, moisture, vibration and shock.

- RATED AT 5, 10, 25, 50, 100 and 250 watts
- RESISTANCE RANGE from 0.1 ohm to 175K ohms, depending on type
- TOLERANCES: ±0.05%; ±0.1%; ±0.25%; ±0.5%; ±1%; ±3%
- TEMPERATURE COEFFICIENT 20 P.P.M.
- OPERATING TEMPERATURE RANGE from -55° C. to 275° C.
- WELDED CONSTRUCTION from terminal to terminal
- RUGGEDLY HOUSED; sealed in silicone and inserted in radiator finned aluminum housing
- SMALLEST IN SIZE, ranging from ⅝" x ⅝" to 3" x 4½"
- SURPASS applicable paragraphs of MIL-R-18546B (Ships)

Circle 98 on Inquiry Card

"SPECTRO" D-C POWER SUPPLIES

Current Regulated, Transistorized for every Scientific Research need



Whether your current regulated power supply requirement is in the 40V, 100V or 200V range, one of these Spectromagnetic Industries units can do the job, and hold regulation to 0.1%, 0.01% or 0.001% as required. (Any of the three series can also be had voltage regulated to the same degree of regulation if you prefer.)

Model Number	Max. D.C. Output-Current (Amperes)	Max. D.C. Output-Voltage	Input
40 VOLT SERIES			
TC40-5	5	40	115vSP
TC40-10	10	40	115vSP
TC40-15	15	40	115vSP
TC40-30	30	40	115vSP
TCV 40 VOLT SERIES			
TCV40-5	5	40	115vSP
TCV40-10	10	40	115vSP
TCV40-15	15	40	115vSP
TCV40-30	30	40	115vSP
HIGH CURRENT SERIES			
TC100-C	50	100	220v3p
TC100-D	100	100	220v3p
TC100-E	125	100	220v3p
TC100-F	150	100	220v3p
TC100-G	200	100	220v3p
200 VOLT SERIES			
TC200-5	5	200	115vSP
TC200-10	10	200	115vSP
TC200-15	15	200	220vSP
TC200-30	30	200	220vSP

The newest addition to the family is the TCV40 series. This unit can be used as a current regulated or voltage regulated supply at the turn of a switch. Current regulation is held to 0.02%, or voltage regulation is held to 0.01% as you require. Available for rack mounting or in cabinet as illustrated, this new unit displays all the attention to quality and detail that you have come to expect from all Spectromagnetic Industries equipment.

All Spectromagnetic Industries power supplies are conservatively rated, and contain many features developed by our engineers while working out special problems.

If your application needs a modification of one of our standard units, or a completely custom piece of equipment, please detail your requirements in a letter.

SPECTROMAGNETIC INDUSTRIES
P.O. Box 3306, Hayward, California
Gentlemen: Please send me literature on
☐ 40 Volt Series ☐ TCV40 Volt Series
☐ High Current Series ☐ 200 Volt Series

Name ____________
Organization ____________
Address ____________
City and State ____________
Position ____________

SPECTROMAGNETIC INDUSTRIES
P. O. Box 3306 • Hayward, California • Telephone SU 2-1300

As We Go To Press (cont.)

Antenna Assigned To Harvard by USAF

An 85 foot diameter radio telescope will be erected at Harvard University's radio astronomy field station in Fort Davis, Texas. Installation of the antenna, designed and made by Blaw-Knox Co., Pittsburgh, will be completed this year.

Remote location of the antenna is expected to minimize man-made interference such as broadcasting and telecasting equipment, industrial machinery, automobile and truck ignition systems, and other earthly noise sources.

The antenna will be used to study radio emissions penetrating the earth's outer atmosphere. It will probably be directed to the sun for a specific study of the radio waves emitted from the solar atmosphere. The antenna is being assigned to Harvard by the Geophysics Research Directorate of the USAF which is financing construction of the instrument.

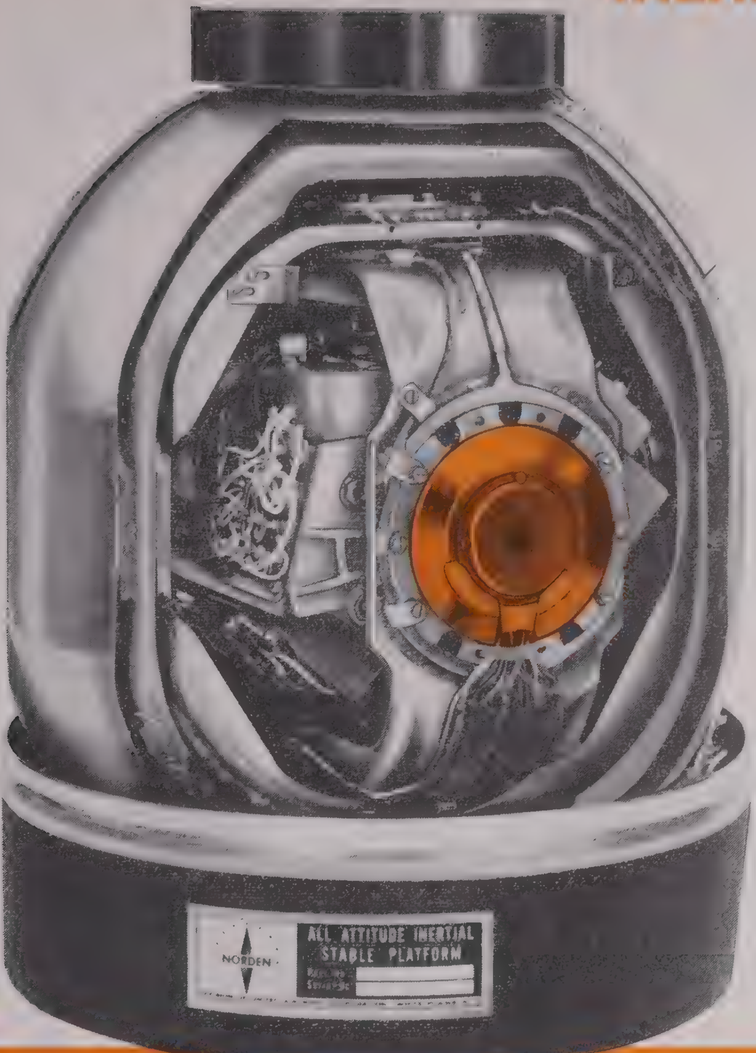
Heart Beat Totalizer

An accurate and convenient way of measuring a person's heart beat night and day, while the wearer continues his normal way of life, has been developed by Lockheed Missiles & Space Division scientists. This was accomplished by an ingenious but simple conversion of an inexpensive wrist watch and by wiring the watch to a tiny amplifier weighing only one ounce.

Previously, the changing rate of the heart beat could readily be measured only while the subject was in bed or sat next to bulky instruments. The Heart Beat Totalizers have been pronounced totally satisfactory, except for one bug—an electric shaver will interfere with the heart beat count, and the electrical interference caused by the ignition system in some older model cars is also stronger than the heart voltage.

Through a tiny amplifier, weighing less than an ounce, the heart beat rate is recorded on an altered wrist watch.

INLAND d-c torque motors save critical weight in guidance systems



Norden Miniature All-Attitude Inertial Platform uses four Inland torque motors, one for each gimbal axis.

Norden specifies these Inland d-c torque motors because of their compact pancake shape, low-power input and direct torquing. In addition to providing the obvious weight and space reduction, Inland's direct drive positioning eliminates gear train problems such as backlash.

Norden engineers say, "The linearity of the Inland torquers is excellent over a wide range so that precession rates may be accurately established. The torquer fixed field is carefully stabilized so that the torquer gradients will be constant over long periods of time."

Inland d-c pancake torque motors with high torque-to-inertia ratios and linearity of output provide all the advantages of direct gearless servo positioning in a complete line over the full range of 0.1 to 3,000 pound-feet.

PLATFORM SHOWN ½ SIZE

COMPARE THESE TYPICAL INLAND TORQUER RATINGS

	T-1321-A	T-2136-A	T-2108-B
Peak torque, oz. in.	20.0	35.0	60.0
Volts at peak torque, stalled at 250°C	48.0	26.0	25.6
Amps at peak torque	1.21	1.6	1.24
Total friction, oz. in.	0.5	0.8	1.5
Rotor Inertia, oz. in sec²	.001	.007	.011
Weight, oz.	5.0	9.0	14.0
Dimensions (inches):—O.D.	1.937	2.81	2.81
I.D.	.625	1.00	1.00
Thickness	.50	.63	1.00

For complete catalog with engineering data, outline drawings and specifications on these and other Inland d-c pancake torquers, write Inland Motor Corporation of Virginia, Northampton, Massachusetts. Dept. 8-9.

INLAND MOTOR CORPORATION OF VIRGINIA
A SUBSIDIARY OF KOLLMORGEN CORPORATION
NORTHAMPTON, MASS.

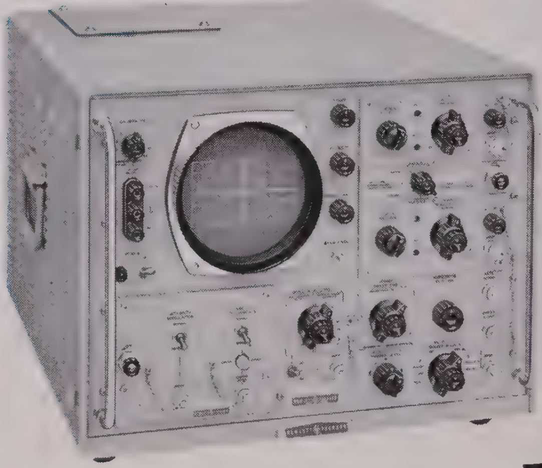
Circle 27 on Inquiry Card

High quality, high reliability plus

PLUG-IN VERSATILITY

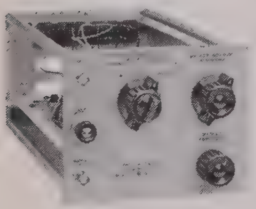
hp 170A MILITARIZED SCOPE — TO 30 MC!

hp 160B MILITARIZED 15 MC SCOPE

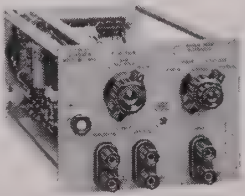


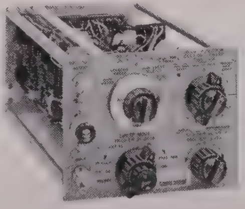
Seven horizontal, vertical plug-ins give

hp 166A Plug-in *(Time-Axis) furnished with the hp 160B and 170A Oscilloscopes (as pictured above), provides standard input connections for Z-axis modulation and single-sweep arming.*



hp 166B Time Mark Generator *(Time-Axis plug-in) makes precise time measurements simple, provides intensity-modulated time markers on the oscilloscope trace of either hp 160B or 170A. Markers, at 0.1, 1 and 10 µsec intervals, speed, simplify photographs, calibration of fast oscilloscope sweeps and operation between calibrated sweep ranges with sweep vernier. Markers may also be used as triggers or for calibration of other devices. Accuracy is ± 0.2%, 10° to 30° C. hp 166B, $130.00.*





hp 166C Display Scanner *(Time-Axis plug-in) provides output to duplicate, on an X-Y recorder, any repetitive waveform appearing on CRT trace. Resolution with permanent, large-scale records is higher than either scope CRT or photograph, and you can observe the scope trace while records are made. Unit converts high speed signals to slower signals having the same waveshape; scanning speed is arranged to keep Y output within the bandwidth of conventional recorders. hp 166C, $300.00.*

hp 166D Sweep Delay Generator *(Time-Axis plug-in) delays the main sweep of the 160B and 170A Scopes for detailed examination of a complex signal or pulse train. In addition, it offers a unique mixed sweep feature to show an expanded segment of a delayed waveform while still retaining a presentation of earlier portions of the waveform. Delay time 1 µsec to 10 sec. Delaying sweep, 18 ranges. Delayed length 0 to 10 cm. Delay functions: trigger main sweep, arm main sweep, mixed sweep. hp 166D, $325.00.*

in these hp OSCILLOSCOPES

Vertical or horizontal plug-ins make possible

- Dual trace amplification
- Fast pulse amplification
- High gain amplification
- X-Y records of repetitive waveforms
- New sweep delay convenience
- Time markers for photos, calibration

Both oscilloscopes are highly ruggedized; both have conventional controls for simple, swift operation

Built to exacting military specifications, these hp oscilloscopes offer instantly expandable measurement capability—*when you need it*. It's easy! Just add a moderately priced plug-in unit!

Both hp 160B and 170A employ the same vertical and time-axis plug-ins providing the widest range of application with minimum investment.

New hp 160B and 170A meet MIL specifications for shock, vibration, humidity and temperature. Important features include high stability tube/transistor circuits, regulated dc filament voltages and premium components throughout.

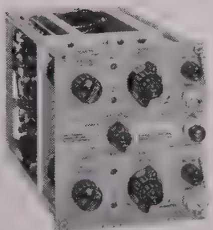
Etched circuits on translucent epoxy glass provide great mechanical stability and simplify circuit tracing. Improved preset triggering insures optimum operation for almost all conditions with just one adjustment—even on signals down to 2 mm deflection. A pushbutton beam finder automatically locates an off-screen beam or trace, especially important during operation by inexperienced personnel.

SPECIFICATIONS—hp 160B and 170A with hp 166A Plug-in

VERTICAL	
Bandwidth:	hp 160B, > 15 MC; hp 170A, > 30 MC
Voltage Calibrator:	18 calibrated ranges ± 3%, 0.2 mv to 100 v peak to peak
HORIZONTAL	
Bandwidth:	DC to 1 MC
Sensitivity:	7 ranges 0.1 v/cm to 10 v/cm. Vernier extends minimum sensitivity to 25 v/cm
Input Impedance:	1 megohm shunted by 30 pf
SWEEP GENERATOR	
Internal Sweep:	24 ranges, 0.1 μsec/cm to 5 sec/cm, ± 3%. Vernier extends slowest sweep to 15 sec/cm
Magnification:	7 ranges, X1, X2, X5, X10, X20, X50 and X100. Increases fastest sweep to 0.02 μsec/cm
Triggering:	Internal, power line or vertical input signal (2 mm or more vertical deflection); external (½ v peak to peak or more). Trigger level of external sync signal adjustable –30 to +30 volts
PRICE:	hp 160B, $1,850.00 (cabinet or rack mount) hp 170A, $2,150.00 (cabinet or rack mount)

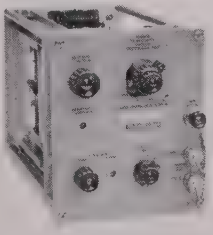
hp 160B, 170A unmatched usefulness

hp 162A Dual Trace Amplifier



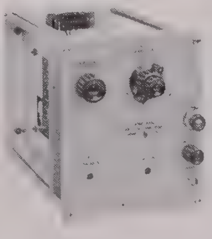
plug-in (vertical) gives maximum sensitivity to 20 mv/cm, permits viewing of two phenomena simultaneously, offers differential input for common mode rejection. Electronic chopping extends simultaneous viewing of 2 signals to lower frequencies without flicker. hp 162A, $350.00.

hp 162D High Gain Vertical Amplifier



increases sensitivity to 5 mv/cm. 12 calibrated ranges, 5 mv/cm to 20 v/cm in 1, 2, 5, 10 sequence, accuracy ± 5%. Continuous vernier extends min. sensitivity to 50 v/cm. Differential input with at least 40 db common mode rejection included for ranges 5 mv/cm through 50 mv/cm. AC or dc coupling of either of two inputs. hp 162D, $225.00.

hp 162F Fast Rise preamplifier



Vertical plug-in allows full utilization of the excellent transient response of the 160B and 170A main vertical amplifiers. Rise time with hp 170A is 12 nsec, dc to 30 MC; with hp 160B is 23 nsec, dc to 15 MC. Sensitivity is 0.05 v/cm to 50 v/cm, covered in 9 ranges; input impedance 1 megohm with 25 pf shunt. hp 162F, $145.

Data subject to change without notice. Prices f. o. b. factory.

HEWLETT-PACKARD COMPANY
7268B Page Mill Road   Palo Alto, California, U.S.A.
Cable "HEWPACK"   DAvenport 6-7000
Sales representatives in all principal areas

HEWLETT-PACKARD S. A.
Rue du Vieux Billard No. 1   Geneva, Switzerland
Cable "HEWPACKSA"   Tel. No. (022) 26. 43. 36

7268

Circle 29 on Inquiry Card

LET MUELLER MAKE IT!

Mueller Brass Co. of Port Huron is much more diversified than the name "Brass" implies . . . a lot more. In fact, because of its many and varied facilities . . . its *men, methods* and *metals* . . . Mueller is in the unique position of being able to offer true single source service.

MUELLER HAS THE MEN . . . experienced engineers with the ability to work out, creatively, tough design problems, and improve a part or components for production by the most economical method. You get sound engineering plus 44 years of practical metalworking production experience when you "Let Mueller Make It."

MUELLER HAS THE METHODS . . . when you "Let Mueller Make It", you are utilizing one single source that is able to produce parts any one of these ways: as forgings, impact extrusions, sintered metal parts, screw machine products, formed tube or as castings.

MUELLER HAS THE METALS . . . and the materials . . . to produce precision parts in aluminum, brass, bronze, copper, iron, and steel in hundreds of different alloys to meet each exact requirement.

In addition, Mueller Brass Co. has complete and modern facilities for performing all types of finishing and sub-assembly operations. Another plus value is nation-wide sales engineering service.

So, in the final analysis, no matter where you fit in the American industrial picture, whether you're making missiles or mowers...and no matter where you're located, it will pay you to LET MUELLER MAKE IT!

MUELLER BRASS CO.
PORT HURON 24, MICHIGAN

Circle 31 on Inquiry Card

Tele-Tips

TEETOTALER ENGINEERS are finding themselves at a disadvantage in this age of jet travel. One of our EI staffers, just returned from a 7000 mile trip around the country, complains that on every airplane he traveled on whiskey was readily available; but he had a hard time getting a cup of coffee, his favorite drink.

BEST SELLERS among the 21 publications available from the Federal Aviation Agency to assist pilots have rung up more than a million sales, with a dollar value more than $800,000. The FAA's best sellers are: "Facts of Flight," on sale since 1947 with a record of 286,298 copies sold; "Path of Flight," 1946 which has sold 485,599; "Realm of Flight," 1946, which sold 455,096.

NOMAD I is a unique automatic weather station, 10 x 20 ft. in size floating unattended in the Gulf of Mexico to provide weather data to the U. S. Government. NOMAD's prime concern is detecting hurricane signs, since hurricanes originate over water.

THE GUIDED MISSILE SCHOOL conducted by Army Ordnance, Huntsville, Ala., has already trained some 1500 foreign students since 1957. The men have come from twelve nations, the largest number—698—from Italy. West Germany is second with 211.

ARTIFICIAL SAPPHIRES will cover the surface of the communication satellites now being developed by Bell Labs. The sapphires will protect solar cells from space radiation, enabing the satellites to endure the rigors of space for ten years or more. The sapphires will convey heat away, preventing the solar cells from overheating in long periods of continuous sunlight.

SPACE SCIENTISTS have increased the strength of pure silver five times by blending in a small percentage of tiny sapphire "whiskers." Scientists at G.E.'s Missile and Space Vehicle Dept. said that similar techniques applied to high strength metals can be expected to produce materials several times stronger at white heat than any high strength alloy.

RUSSIA, IT SEEMS is beginning to suffer from typical capitalistic ailments. The Russian communications magazine, "Radio" reports complaints from one TV owner that 25 different repairmen worked on his TV set, that it is still on the blink. The article goes on to blame the Ministry of Communication's habit of assigning unrealistic production quotas to TV factories and repair shops.

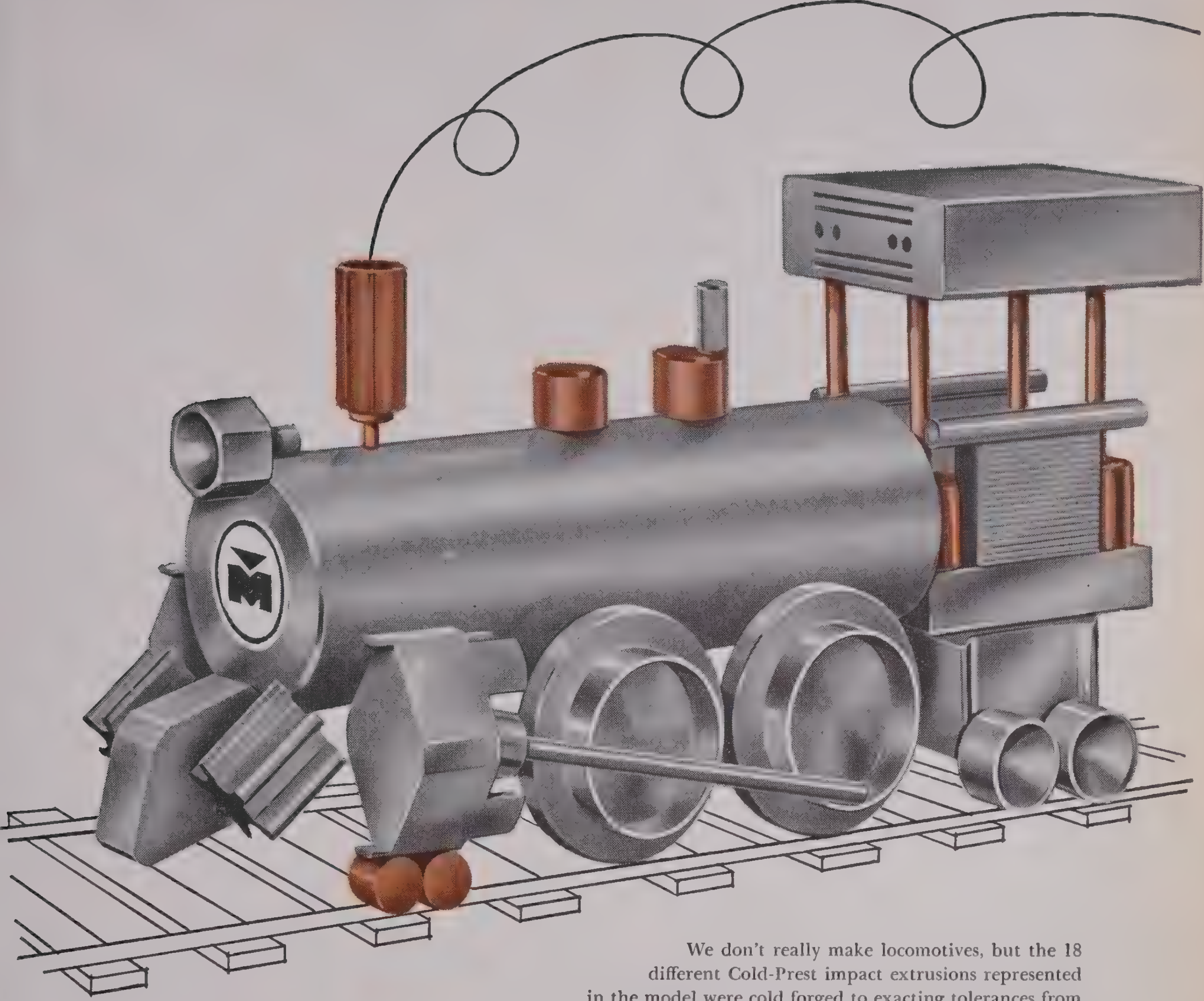
CAN COMPUTERS give birth to other computers? Not yet — but National Bureau of Standards is running out of a limited application of the problem in developing the advanced model computer known as PILOT. NBS scientists are using an "old-fashioned" computer to determine the most advantageous layout of electrical circuits.

USSR JOURNAL points out that workers exposed to ultrasonic waves and intense high frequency noises show a tendency towards hypertension, fatigue and general irritability.

LARGEST FLOATING TV STATION may be that aboard the USS Franklin D. Roosevelt, giant aircraft carrier with the Sixth Fleet. The closed-circuit TV system installed on the carrier includes facilities for telecasting programs offered by mainland stations and the carriers cruising nearby or docked. The crews have watched telecasts from such ports as Brisbane and Bangkok.

ROCKETRY sounds exotic, but the humble beginnings are close at hand to the average housewife. Aerojet General points out the role of simple household essentials in getting man into space: vinegar and salt, for instance, are used for certain processes in making rocket fuels. And so is bicarbonate of soda. What the housewife knows as lye, rocket scientists call sodium hydroxide, and use it to purify rocket fuels. Laundry bleach — sodium hypochloride — is an ingredient of rocket engine fuel, as is ethylene glycol, the familiar automobile anti-freeze. Cigarette lighter fluid and spot remover also find use in rocket propellant manufacture, being used in chemical analyses.

MUELLER CAN MAKE MOST ANYTHING IN IMPACT EXTRUSIONS...



We don't really make locomotives, but the 18 different Cold-Prest impact extrusions represented in the model were cold forged to exacting tolerances from a number of aluminum, copper, brass, and steel alloys.

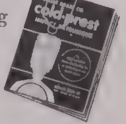
These parts are employed in products ranging from door closers to missiles. Mueller has also made important advances in the production of copper impact extrusions that are especially adaptable to electronic applications. Cold forgings are precision produced to exacting tolerances and offer the additional advantage of a better finish and appreciable metal savings.

Mueller's flexible facilities for the production of Cold-Prest Impact extrusions make practical long or short runs of simple or relatively complex shapes on an economical basis. In addition, the entire Mueller engineering staff, excellent machining, finishing and assembly facilities are readily available to you when you . . .

LET MUELLER MAKE IT!

MUELLER BRASS CO.
PORT HURON 24, MICHIGAN

Write today for Engineering Manual No. FM-3019



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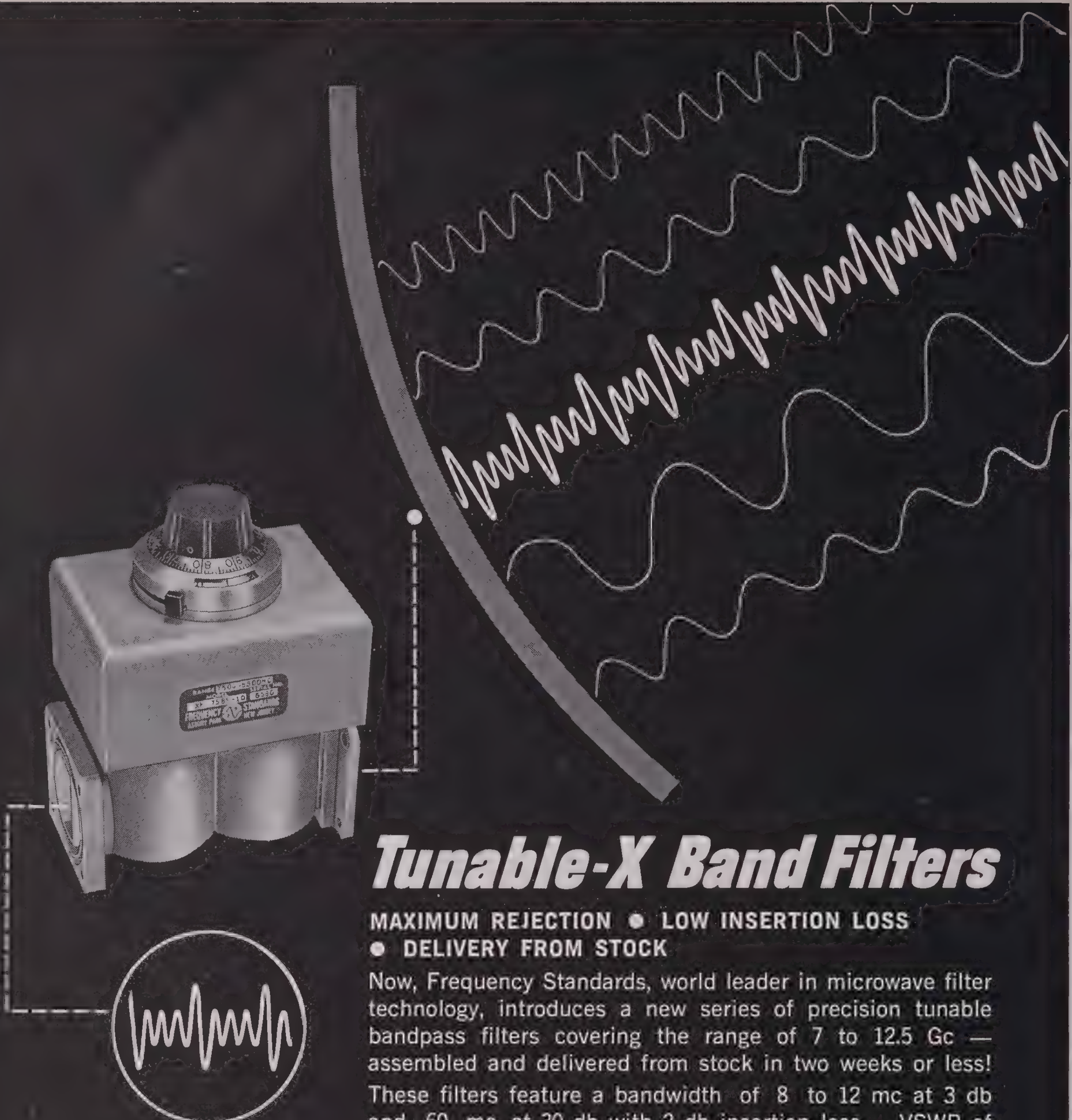


Tunable-X Band Filters

MAXIMUM REJECTION ● LOW INSERTION LOSS ● DELIVERY FROM STOCK

Now, Frequency Standards, world leader in microwave filter technology, introduces a new series of precision tunable bandpass filters covering the range of 7 to 12.5 Gc — assembled and delivered from stock in two weeks or less!

These filters feature a bandwidth of 8 to 12 mc at 3 db and 60 mc at 30 db with 2 db insertion loss . . . VSWR of 1.5 max. at F_0 . . . temperature stability of 3 cps/Mcs/°C maximum drift over wide temperature range . . . two direct-coupled TE_{111} mode cylindrical cavities with single tuning control . . . counterdial and calibration chart or slotted shaft adjustment. Price: $398.00 each (less quantity discount).

Frequency Standard's 14 years of experience in the development and production of high performance microwave filters is available to you without obligation. Look into our capabilities for special preselectors with balanced mixer as well as low bandpass and band rejection filters for both high and low power applications. Write for Bulletin P-26102 or send specific bandwidth and other requirements to Department KF.

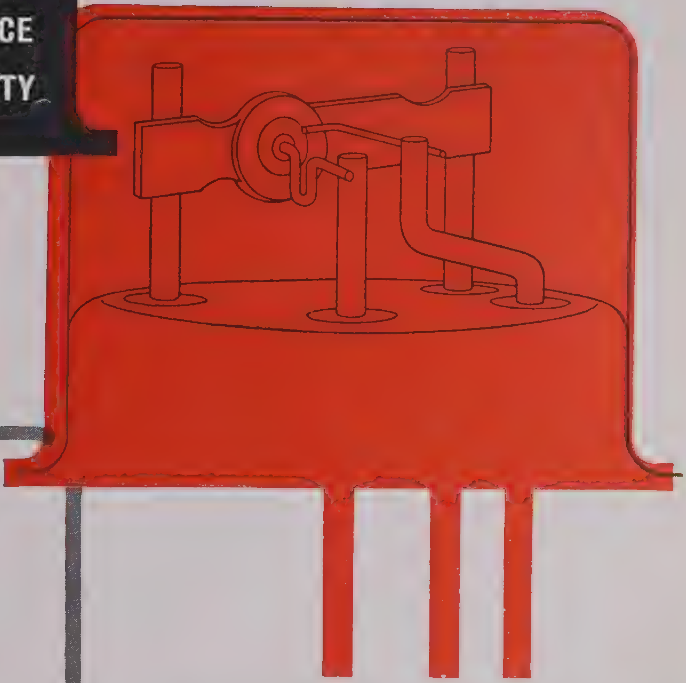
FREQUENCY STANDARDS

A DIVISION OF HARVARD INDUSTRIES, INC.
BOX 504 · ASBURY PARK, N. J. · PROSPECT 4-0500

Center for new ideas in microwave technology— Discriminators, Antenna Couplers, Diplexers, Wavemeters, Reference Cavities, Signal Sources, Directional Couplers, Antennas, Cavities

22 FACTS—PROVE RAYTHEON 2N338 SILICON TRANSISTORS

GIVE YOU FASTER SWITCHING—IMPROVED CIRCUIT PERFORMANCE—COMPLETE INTERCHANGEABILITY



New Designer's Handbook on Raytheon 2N338. Get complete details on the 22 reasons why the Raytheon 2N338 is mechanically and electrically superior for all switching and amplifier applications. Forty-eight curves, charts, and circuit diagrams measure Raytheon's performance against other manufacturers' — show you how you can get greater circuit efficiency with the Raytheon 2N338. Call or write the Raytheon office nearest you for your copy.

Raytheon's 2N338 switches faster, performs better throughout the frequency and temperature range than competitive types. Twenty-two superior features incorporating dramatic advances in new materials and processes, make the Raytheon 2N338 the finest medium frequency silicon transistor available. You get increased safety factors plus the benefits of complete interchangeability with other 2N338 types.

Adapted from techniques and processes developed under Signal Corps contract, DA-36-039-SC-72710, the Raytheon 2N338 is also available as a MIL type (MIL-S-19500/69C [NAVY]).

The benefits of this construction are also available in Raytheon's entire series of NPN silicon transistors—2N332, 2N333, 2N334, 2N335, 2N336, 2N337.

RAYTHEON COMPANY

RAYTHEON

SEMICONDUCTOR DIVISION

SILICON AND GERMANIUM DIODES AND TRANSISTORS • SILICON RECTIFIERS • CIRCUIT-PAKS

BALTIMORE, MD., SOuthfield 1-0450 • BOSTON, MASS., DEcatur 2-7177 • CHICAGO, ILL., NAtional 5-4000 • DALLAS, TEXAS, LAkeside 6-7921 • DAYTON, OHIO, BAldwin 3-8128 • DETROIT, MICH., TRinity 3-5330 • ENGLEWOOD CLIFFS, N. J., LOwell 7-4911 (Manhattan, Wisconsin 7-6400) • LOS ANGELES, CAL., PLymouth 7-3151 • ORLANDO, FLA., GArden 3-0518 • PHILADELPHIA, PA., (Haddonfield, N. J.), HAzel 8-1272 • SAN FRANCISCO, CAL., (Redwood City), EMerson 9-5566 • SYRACUSE, N. Y., HOward 3-9141 • CANADA: Waterloo, Ont., SHerwood 5-6831 • GOVERNMENT RELATIONS: Washington, D.C., MEtropolitan 8-5205

Circle 33 on Inquiry Card

Does expensive crating of exhibits, electronic devices and other delicate equipment account for a big chunk of your shipping cost? Then take a few minutes to talk with your local United Agent about **SAFE-GUARD . . .** the moving service that combines *economy* with safety. Let him show you how cushion-soft padding, special handling techniques and custom-designed vans eliminate the need for crating on most shipments. See how much you'll save in man-hours and money compared with bulky crate-and-ship methods.

Get the full facts today from your nearby United Agent. Just look for the United under "MOVERS" in the Yellow Pages.

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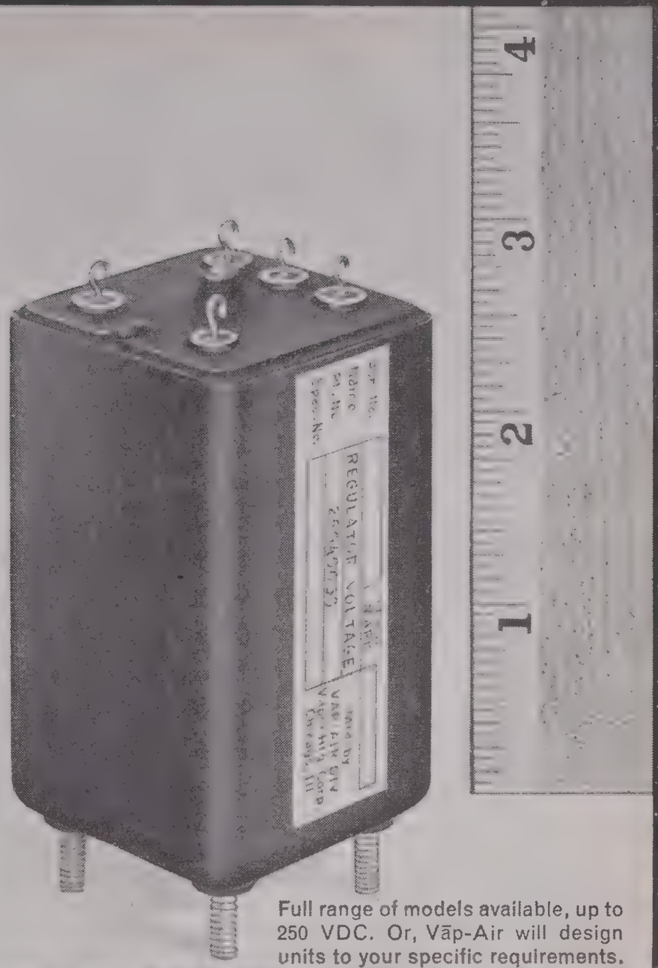
INTERNATIONAL HEADQUARTERS • ST. LOUIS 17, MISSOURI

Circle 34 on Inquiry Card

VĀP-AIR 10 V.D.C. POWER SUPPLY...

with regulation accuracy ± .01%

This compact dual function constant voltage regulator is used in a missile telemetering application. The regulator provides a low voltage reference supply of 10 VDC; it also contains an inverter which furnishes a de-commutating voltage of —0.5 VDC. Small, lightweight, and accurate, it provides close regulation of voltage over a wide temperature range. Components are held to a minimum to achieve highest reliability with optimum performance. The unit meets all environmental conditions of MIL–E–5272C.



Full range of models available, up to 250 VDC. Or, Vāp-Air will design units to your specific requirements.

VĀP-AIR... COMPLETE CONTROL CAPABILITIES

Entire systems and a complete line of sensors, electronic controls and precise power supplies, electro-pneumatic and electro-mechanical valves, advanced in-line air valves and regulators, electric power controllers and heat exchange equipment—for aircraft, missiles, and ground support devices.

BRIEF SPECIFICATIONS

Input Voltage	22 to 29 VDC
Output Voltage No. 1	9.950 to 10 VDC
(under all input, load & temperature conditions)	
Output Voltage No. 2	−0.5 VDC @ 100K ohm load
Output Current (10V)	0-100 MA
Output Ripple (10V)	
Normal Operation	Zero
Transient Condition	30 MV peak to peak
Input Transient	80 volts above zero level for 10 to 20 millisecond duration
Temperature Range	−65° to +185° F
Size	1-1/2″ x 1-1/2″ x 2-3/4″
Weight	6-1/2 ounces
Environmental	MIL-E-5272C

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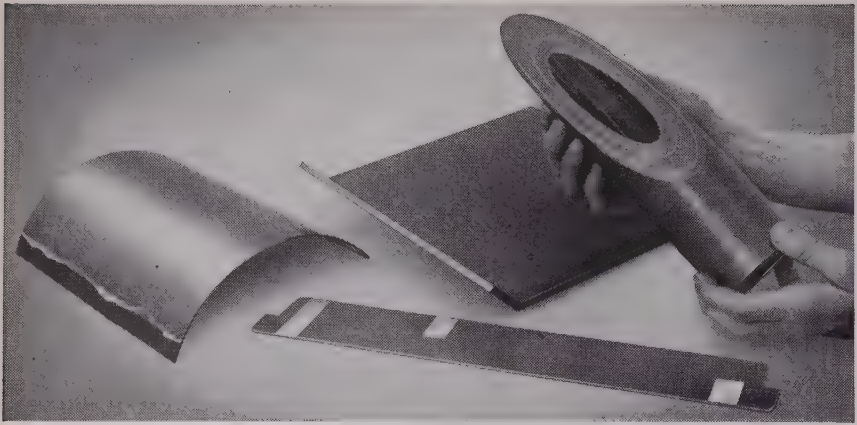
Important facts to know about laminated plastics



A few Taylor composite laminates (left to right): copper-clad section; sandwiched copper component; Taylorite vulcanized fibre-clad part; laminated tube, copper inserts.

Composite Laminates Open Up New Design Opportunities

While the great variety of commercially available laminated plastics satisfy most electrical and mechanical requirements, there are applications that can benefit from the combination of properties provided by composite laminates. Recent advances in bonding techniques have made it possible to bond virtually any compatible material with a laminate. These can be supplied as clad or as sandwiched materials. And they can be molded into many shapes to fit design requirements. Taylor is presently supplying to order the following composite laminates:

- **Copper and laminated plastics.** Clad for printed circuits and formed shapes. Sandwiched for special applications.
- **Taylorite® vulcanized fibre-clad laminates.** These combine the high strength of laminated plastics with the superior hot-arc-resistance of vulcanized fibre. They are being used in both high and low-voltage switchgear applications. Also in applications where the high impact strength of vulcanized fibre may be advantageous.
- **Rubber-clad laminates.** Almost any type of natural or synthetic rubber may be used as the cladding material. These laminates are widely used for condenser tops in wet condensers to protect the laminate against highly alkaline electrolytes. They also have application in any part where sealing or chemical resistance is needed.
- **Asbestos-clad laminates.** For applications where high heat- and arc-resistance are required.
- **Laminate-clad lead.** Lead sheets sandwiched between Grade XX paper-base laminates have been used for X-ray shields. The laminate provides strength and contributes to the high shielding properties of the lead.
- **Aluminum-clad laminates.** These have been used extensively for engraving stock. They also offer possibilities as printed-circuit material and as plate holders for X-ray machines.
- **Beryllium copper-clad laminates.** Beryllium copper is nonmagnetic and a good conductor—properties that give these laminates possibilities in many applications.
- **Stainless steel-clad laminates.** Applications where nonmagnetic properties are required. Also in certain corrosive environments where the resistance of stainless steel to attack is an asset.
- **Magnesium-clad laminates.** These laminates have been produced in 108-in.-long sheets for use as screens for X-ray operators. Weight was a factor.

Our design and production engineers are constantly developing new materials, new applications, and new procedures for fabricating laminated plastics. Our experience is yours for the asking. And if you have a problem requiring assistance or more information on composite laminates, write us. Also ask for your copy of Taylor's new guide to simplified selection of laminated plastics. Taylor Fibre Co., Norristown 53, Pa.

Taylor

LAMINATED PLASTICS · VULCANIZED FIBRE

As We Go To Press (cont.)

Puerto Rico Awarded Electronics Contract

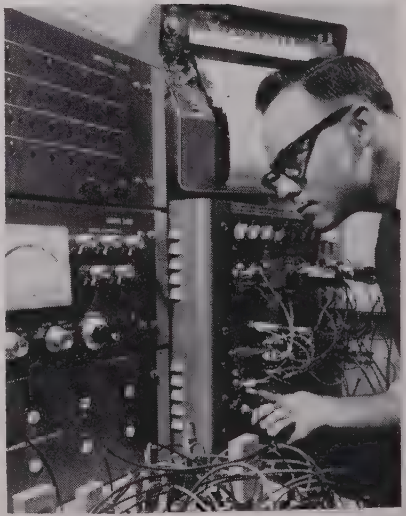
U. S. Army Signal Corps has awarded a $479,000 contract for telephone handsets to Electrospace Corp. of Valley Stream, N. Y. The handsets are to be manufactured at the company's new Puerto Rico plant, 30 miles from San Juan. It is the first U. S. military contract for production of electronics equipment which Puerto Rico has received.

Alex Higuera of the Economic Development Administration of the island commonwealth said that more military electronics contracts are expected shortly, adding, "It appears as though the U. S. Defense Department is fully confident in the ability of Puerto Ricans to do a first-class job of quality control on intricate equipment for the military."

Data Processing System For Department Stores

J. C. Penney Co., national retail department store chain, has introduced a new electronic data processing system into its Pittsburgh regional credit office to handle accounts receivable in its credit program. The IBM 1401 data processing system with magnetic tape will process charge accounts for 116 Penney stores in Pa., Ohio, Mich. and West Va.

MINUTES EQUAL MONTHS



Minutes equal months on this analog computer used by Minneapolis-Honeywell temperature engineers to duplicate climate and building conditions anywhere in the world. Research engineer Donald Nelson can obtain in 15 minutes technical data that would normally take years to assemble. It is used to evaluate performance capabilities of new temperature controls.

et valuable information on advanced measuring techniques

APPLICATION NOTES

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HEWLETT PACKARD

FREQUENCY AND TIME STANDARDS

APPLICATION NOTE 52

PRINTED 3/61
00031-1

ADVANTAGES OF SINGLE CYCLE OPERATION

The ability to produce a single cycle from the 202A Low Frequency Function Generator permits its use as a source for observing the transient response of networks and systems rather than being limited to observations of steady state characteristics.

METHOD

The method for single cycle operation consists of triggering the 202A circuit externally with single pulse which initiates one cycle of 202A operation. The only additional equipment required is an external single pulse source, a 185 volt source (or a potentiometer) and a diode.

(OA3), as shown by the dotted lines in Figure 6 and adjusting the output for the proper voltage. The 185 volts should be established prior to the insertion of the diode to avoid exceeding the maximum back voltage of the 212-G11A (75 vdc).

If you prefer you may omit the potentiometer and insert a 185 volt power supply or battery between the terminals A-B shown in Figure 5.

B. Either capacitor C-10 or C-13 should be open-circuited from the plate of V-3(6AL5). A negative pulse of at least 3 microseconds duration and 6 volts amplitude applied between the capacitor and B- will drive the 202A generating circuits. With the signal applied to C-10, the output will be a negative cycle; whereas, if the driving signal is applied to C-13, the output is a positive cycle.

Figure 1

HEWLETT-PACKARD COMPANY · 1501 PAGE MILL ROAD · PALO ALTO, CALIF

Hewlett-Packard Application Notes, covering a wide variety of subjects, include both theoretical and "how to do it" information. They are composed of information derived from the experience of ⓗⓟ engineers both in general areas of measurement and in solving specific measurement problems. Many interested readers have found Application Notes useful in the past. You may find them helpful, too. Check this partial list of titles:

- # 2 Frequency Measurement of Low-Level Signals, up to and above 12.4 GC
- # 6 Homodyne Generator Detection System, to measure attenuation, rf leakage, antenna patterns, etc.
- #15 Distortion and Intermodulation
- #36 Sampling Oscillography
- #42 Applications of 416A Ratio Meter, reflectometer techniques
- #43 Continuous Monitoring of Radar Noise Figures
- #44 Use and Usefulness of the 185A 1,000 MC Oscilloscope (44A, Synchronizing the 185A; 44B, Pulse Analysis; 44C, Component Switching Speed Characteristics Measurement)
- #48 Applications of the 218A Pulse and Delay Generator
- #50 How to Make VLF Frequency Comparison Measurements with Standard Laboratory Equipment
- #52 Frequency and Time Standards

Other Application Notes cover such subjects as measuring FM signals, measuring rf pulse carrier frequency, microwave spectrum synthesis, waves on transmission lines, square wave and pulse testing, measurement of cable characteristics, instruments for transducer applications. The Application Notes Index gives a complete listing.

Fill in and mail the attached post card for Application Notes of interest to you, or for a complete list of titles.

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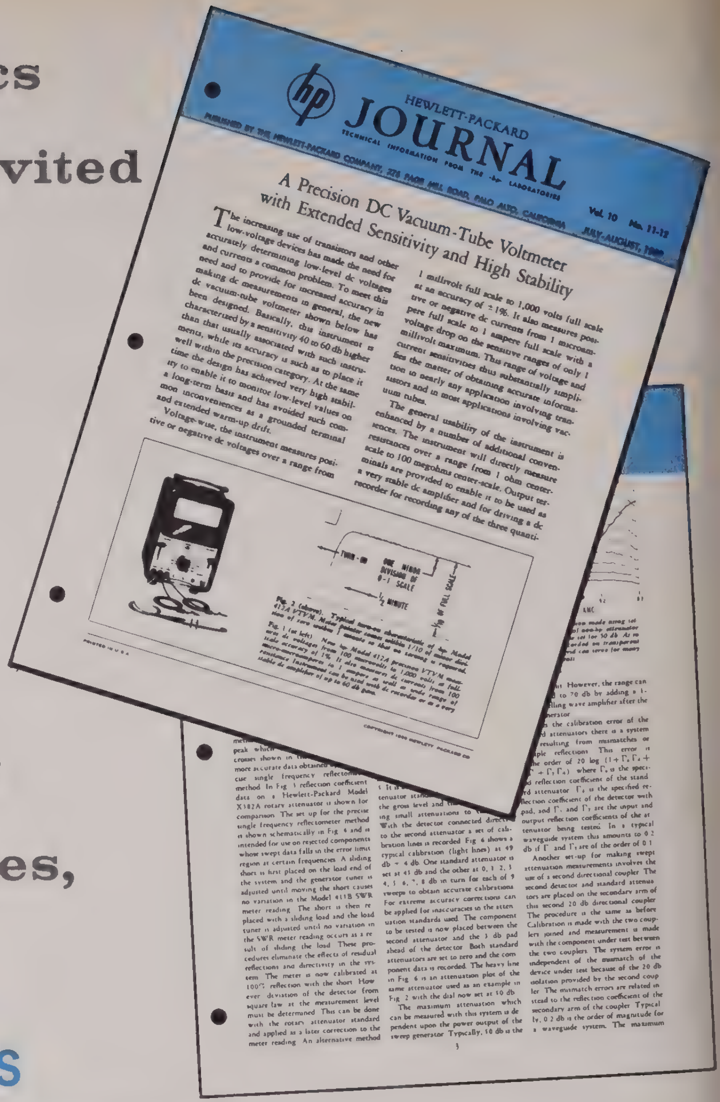
Engineers in electronics and allied fields are invited to join the roster of regular readers of the hp JOURNAL published throughout the year, presenting factual reports on new measurement techniques, new instrumentation.



hp HEWLETT-PACKARD JOURNAL

TECHNICAL INFORMATION FROM THE -hp- LABORATORIES

PUBLISHED BY THE HEWLETT-PACKARD COMPANY, 275 PAGE MILL ROAD, PALO ALTO, CALIFORNIA Vol. 10 No. 11-12 JULY-AUGUST, 1959

A Precision DC Vacuum-Tube Voltmeter with Extended Sensitivity and High Stability

The increasing use of transistors and other low-voltage devices has made the need for accurately determining low-level dc voltages and currents a common problem. To meet this need and to provide for increased accuracy in making dc measurements in general, the new dc vacuum-tube voltmeter shown below has been designed. Basically, this instrument is characterized by a sensitivity 40 to 60 db higher than that usually associated with such instruments, while its accuracy is such as to place it well within the precision category. At the same time the design has achieved very high stability to enable it to monitor low-level values on a long-term basis and has avoided such common inconveniences as a grounded terminal and extended warm-up drift.

Voltage-wise, the instrument measures positive or negative dc voltages over a range from 1 millivolt full scale to 1,000 volts full scale at an accuracy of ±1%. It also measures positive or negative dc currents from 1 microampere full scale to 1 ampere full scale with a voltage drop on the sensitive ranges of only 1 millivolt maximum. This range of voltage and current sensitivities thus substantially simplifies the matter of obtaining accurate information in nearly any application involving transistors and in most applications involving vacuum tubes.

The general usability of the instrument is enhanced by a number of additional conveniences. The instrument will directly measure resistances over a range from 1 ohm center-scale to 100 megohms center-scale. Output terminals are provided to enable it to be used as a very stable dc amplifier and for driving a dc recorder for recording any of the three quanti-

Fig. 2 (above). Typical turn-on characteristic of -hp- Model 412A VTVM. Meter pointer comes within 1/10 of minor division of zero within 1 minute so that no zeroing is required.

Fig. 1 (at left). New -hp- Model 412A precision VTVM measures dc voltages from 100 microvolts to 1,000 volts at full scale accuracy of 1%. It also measures dc currents from 100 micro-microamperes to 1 ampere as well as wide range of resistance. Instrument can be used with dc recorder or as a very stable dc amplifier of up to 60 db gain.

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TYPICAL SUBJECTS

- Improved sweep frequency techniques for broad band microwave testing
- Square wave and pulse testing of linear systems
- Effect of μ-circuit non-linearity on the amplitude stability of RC oscillators
- A new frequency counter plug-in unit for direct frequency measurement to 510 MC
- Two versatile new power supplies for high power semiconductor work
- An improved method for measuring losses in short waveguide lengths

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Letters to the Editor

DC Restorer—Or Not?

Editor, ELECTRONIC INDUSTRIES:

Regarding "A Simple Inexpensive DC Restorer" by Oliver K. Allen, in the April, 1961 issue.

The improvement in picture quality that should result by the use of a DC restorer may be offset by picture size modulation if the HV supply has poor regulation.

It should be pointed out that the average "High Voltage" current varies as a function of picture content when a DC restorer is used. With no DC restorer, the average video voltage between the grid and cathode of the CRT is constant resulting in a constant average anode current (HV current).

If the voltage regulation of the high voltage power supply is poor, the anode voltage will vary as a function of picture content when using a DC restorer. In some CRTs, the deflection sensitivity (picture size) is a function of anode voltage.

The regulation of a power supply is a function of its internal impedance. To lower this value cost money (all other things equal).

When the manufacturer does not design a DC restorer into a set, he not only saves in the cost of the DC restorer but he can place a less severe requirement on the HV regulation (hence, save money).

Since the picture signal (video) from the TV station contains "DC" information, either a DC coupled video amplifier or a DC restorer is essential if faithful reproduction is desired.

Charles Halsted
Development Engineer
Burroughs Corporation
Paoli, Pennsylvania

Writing—Newest Skill

Editor, ELECTRONIC INDUSTRIES:

I am currently attending a course in Engineering Technical Writing given at Fairleigh Dickinson Univ., Teaneck, New Jersey. The article in your March 1961 issue, entitled, *Writing—Newest Engineering Skill,* fully summarizes the major topics being covered in the course. I feel that the article could be used, by the members of the class, as an informal course outline.

Therefore, I am asking you to please send reprints of the article so that I may distribute one to each engineer in the class.

Saul Goldberg
Project Engineer
Kearfott Division
General Precision, Inc.
1150 McBride Avenue
Little Falls, New Jersey

(*Continued on page* 62)

smallest
(maybe)
reliable,
rugged
(definitely)

SERVO
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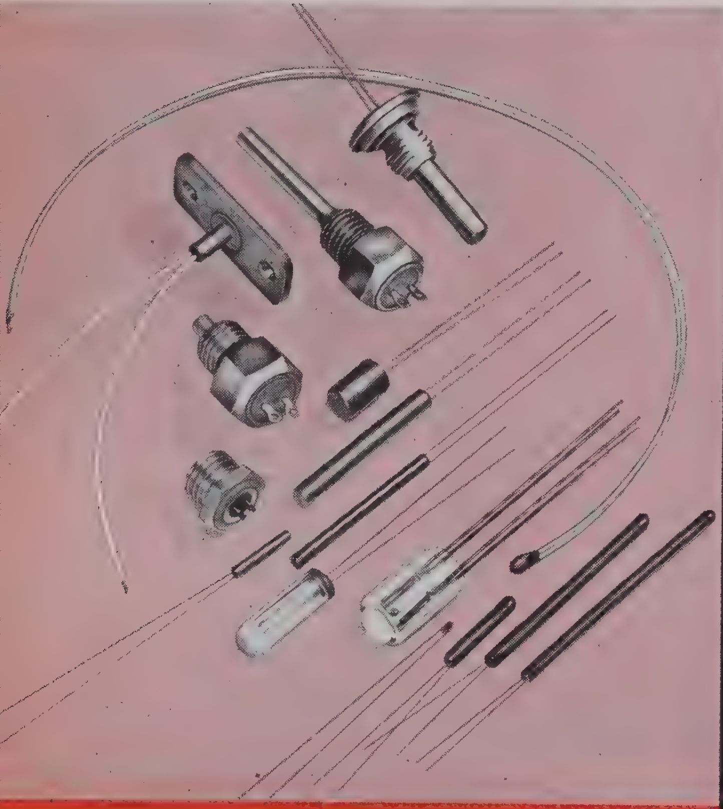
LONG ISLAND, NEW YORK

Circle 41 on Inquiry Card

Keystone BEAD TYPE THERMISTORS



Representative Keystone Bead Type Thermistors
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t Type	R @ 0°C	R @ 25°C	R @ 37.8°C	R @ 104.4°C
03-184-59*	700	280.5	184	31.2
03-329-59*	1,252	500	329	55.8
03-550-71	2,400	872	550	77.5
03-1220-81	6,110	2,010	1,220	150.6
03-1500-88	7,940	2,520	1,500	170.5
03-2900-76*	13,260	4,680	2,900	381.5
03-5K-97	28,300	8,590	5,000	515
03-9K-102	52,000	15,600	9,000	882
03-16920-112	105,300	30.000	16,920	1,511
03-33.3K-125	217,500	60,000	33,300	2,665
03-55.3K-125	365,500	100,000	55,300	4,420
03-180K-145	1,273,000	333,000	180,000	12,400
05-400K-145	2,830,000	740,000	400,000	27,600
04-523K-155*	4,060,000	1,000,000	523,000	33,750

*These units processed for operation to 150° C maximum; all others, to 260° C maximum.

Circle 42 on Inquiry Card

***FAST RESPONSE** in temperature measurement...temperature measurement and control . . . liquid level sensing . . .*

***PLUS** the most uniform operating characteristics of any bead types known!*

- Add *versatility* to these Keystone advantages in low power bead-type thermistors—and you have every good reason for making Keystone your key source for thermistor production requirements!
- The table at left lists basic Keystone units in stock. An almost infinite number of special units can be engineered and furnished to meet your needs. These can be supplied with a wide variety of lead materials to meet your design requirements. Protective coatings, such as glazes, silicone varnishes, durex and cycleweld can be applied, enabling operation in many environmental conditions.
- Due to the special nature of our production processes, our L0503 and L0505 size units provide more uniform operating characteristics than any bead types previously known. These types have a basic unit nominal diameter of .050″ and thickness of .030″ and .050″ respectively. Various configurations call out a time constant of approximately 5 seconds and a dissipation constant of 0.62 milliwatts per degree Centigrade.
- These units can be fabricated in any special configurations, including silver probes, stainless steel probes, glazed ceramic probes, units mounted in headers, on transistor bases, etc.
- Keystone Bead Type Thermistors are available in close-tolerance patterns. Resistance-temperature tolerances are maintained in regular production within the same tolerance limits as other Keystone types.
- May we have your requirements?

Keystone
CARBON COMPANY
Thermistor Division
ST. MARYS, PA.

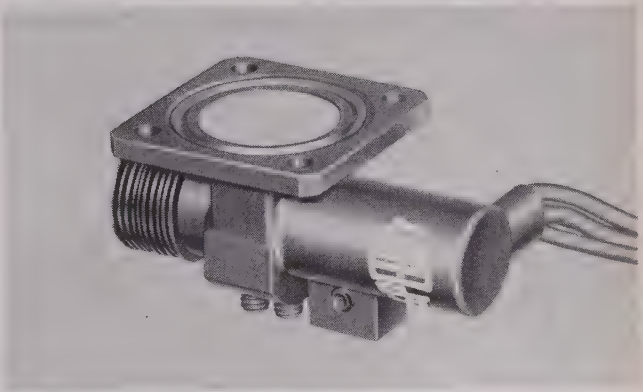
another
microwave memo *from* **SPERRY** ELECTRONIC TUBE DIVISION

Announcing 30-Day Delivery on U Band, Two-Cavity Oscillators For Parametric Amplifier Pumping

Sperry Electronic Tube Division, Gainesville, Florida, announces an *immediate* solution to the drive source problems which have plagued developers of parametric amplifiers for some time. Now Sperry can deliver a U band, two-cavity klystron oscillator in just 30 days.

Fast delivery is possible because development work is completed on all tubes within the frequency and power output parameters described below. Soundness of the development work is already proved, since tubes of this type have been operating in several systems for some time.

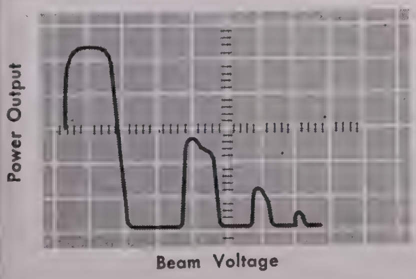
Sperry has developed a whole family of these oscillators. They cover the entire U band, and deliver output powers from 200 mW to 1.5 W.



APPLICATIONS

All tubes in the new Sperry family operate with a characteristic flat-top mode. This constant relationship between beam voltage and output power makes tubes in the series particularly suited for driving parametric amplifiers, and for use in doppler radars and FM communication systems.

One important benefit of the flat-top mode characteristic is the availability of frequency modulation with very low incidental amplitude modulation. This inherent amplitude stability, together with high power output levels, makes the new oscillator family particularly useful for parametric amplifier applications. The same characteristics contribute to the desirability of these tubes for use in doppler radars and FM communication systems.



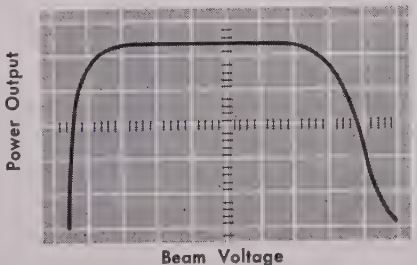
Typical mode shapes of two-cavity oscillator.

RATINGS

Two-cavity oscillators in the Sperry series completely blanket the 12.5 to 18 kMc frequency range covered by the U band. The "family" of tubes is divided into two branches, one ranging from 12.5 to 15.5 kMc, and the other covering the 15.5 to 18 kMc area.

Output power ranges from 200 mW to 1.5 W in the lower frequency group, and from 200 mW to 1 W at the higher frequencies.

If optimum tuned, rather than flat-top mode operation is desired, power output may be increased 25%.



A typical main mode, adjusted for optimum flat-top operation.

INHERENT BENEFITS

Tubes in the new Sperry family enjoy all the inherent benefits of two-cavity klystron design. These include precision tuning, high stability, amazing ruggedness and unusual stability at high output levels.

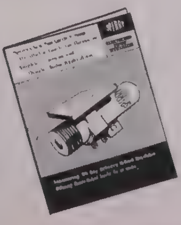
The series incorporates two design features which result in significant size and weight savings.

1. Electrostatic focusing, eleminating the heavy focusing magnets required in many designs.
2. A unique fixed-tuned design, in which the cavities are pressed into a configuration which delivers the customer's specified frequency.

All the tubes in this series show efficiencies in the area of 3.4% with the flat-top mode, and all have low levels of vibration-induced AM and FM noise.

PRICE AND AVAILABILITY

At power output levels from 0.2 to 0.5 watts, tubes in the new Sperry family are priced at $2,295 each. With output from .5 to 1.5 watts, the price is $2,795 each. Tubes will be tuned to your specified center frequency, and they will deliver your specified power output level. All oscillators in this U band series will be shipped within thirty days of receipt of order.



WRITE FOR SPERRY'S NEW BROCHURE which describes the new U band oscillator family in greater detail. For the brochure, or for application assistance and quotation, contact:

R. F. Forlaw, Section 401
Sperry Electronic Tube Division
Sperry Rand Corporation, Gainesville, Fla.

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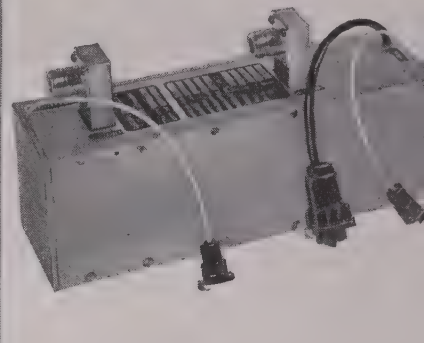
SPERRY ELECTRONIC TUBE DIVISION

Circle 43 on Inquiry Card

PROGRESS IN MICROWAVES

New General Electric TWT's and VTM's . . .

REDUCE SIZE, WEIGHT, AND POWER INPUT OF MICROWAVE RECEIVERS



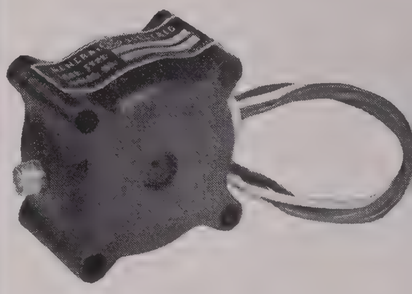
ZM—3113—Low-noise, PM-focused TWT

Recognizing the need for microwave receivers of simpler design, the General Electric Power Tube Department continues to expand its line of light weight, compact, low-noise traveling-wave tubes and voltage-tunable magnetrons.

5-DB, S-BAND, PM-FOCUSED TWT
The most recent example of General Electric's progress in low-noise permanent-magnet TWT's is the ZM-3113, which has a nominal noise figure of 5 db over 2 to 4 kmc. Like other G-E traveling-wave tubes, this ruggedized TWT can be factory-optimized to provide even lower noise factors over narrower bandwidths. The ZM-3113 also has a signal gain of more than 20 db, and meets stringent military environmental specifications.

RAPID TUNING, BOWL-MAGNET VTM
Designed for local oscillator application on rapidly tuned radars, the ZM-6006 voltage-tunable magnetron operates over a frequency band from 2.8 to 3.2 kmc. It has a power output of 3 watts, a maximum voltage input of 1000 volts, and weighs only 1.5 pounds. Maximum noise figure is for the ZM-6006 −92 db in a 30 mc IF amplifier of one megacycle bandwidth.

Sample quantities of both the ZM-3113 TWT and the ZM-6006 VTM are now available with delivery in 90 to 120 days.



ZM-6006—Low-noise, Lightweight VTM

FREQUENCY RANGES AVAILABLE

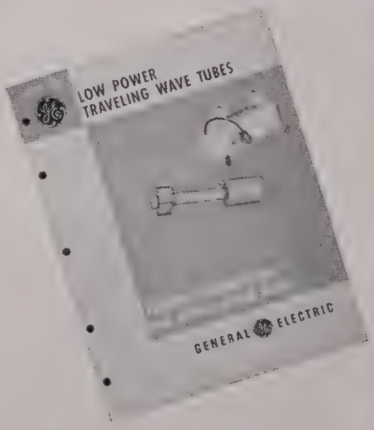
LOW-NOISE TWT'S

Frequency (KMC)	Maximum Noise Figure (db)	Minimum Gain (db)
2—4	6.5	20
4—8	10	25
7—11	10	25
7.5—8.5	7	25
8—12	10	25
14—18	14	25

LOW-NOISE VTM'S

Frequency (KMC)	P_o (Min. CW)
.5—1.0	.5 W
1.0—2.3	1.0 W
2.2—3.85	2.0 W
2.8—3.2	3.0 W

TO ORDER, or obtain more information, contact your nearest Power Tube Sales office (telephone numbers listed below). 265-11-9545-8481-43



For complete details on the theory, engineering, and application of General Electric low power traveling-wave tubes, write to Power Tube Department, General Electric Company, Schenectady, N. Y. Ask for bulletin PT-54.

POWER TUBE DEPARTMENT

GENERAL ELECTRIC

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GENERATORS

LOW FREQUENCY, AUDIO, RF, SWEEP

0.01-1000c 3-phase, 4-phase, and variable-phase outputs for servo and feed-back circuit measurements. 1305-A, $940.

20c-500 kc three generators in one; high- and low-impedance sine-wave outputs, and square-wave output. 1210-C, $180*.

20-15000c in 27 fixed-frequency steps; additional coverage from 2-15c with optional extension unit. Very low harmonic distortion, less than 0.1%. 1301-A, $595.

10c-100 kc extremely stable RC oscillator, output voltage constant ±1 db. 1302-A, $500.

20c-40 kc essentially constant output voltage (±0.25 db for 20c-20 kc), very low distortion. Ideal for frequency-response testing of audio equipment. 1304-A, $680.

20c-12 Mc, and 30 Mc to 42 Mc, sine waves; 20c to 2 Mc, square waves. Can be set to any center frequency from 20 kc to 12 Mc or 36 to 42 Mc and driven at any sweep width up to ±6 Mc. Sweep rate is 60 cps. 1300-A, $1950.

5kc-50 Mc 1 watt output at rf; internal 400- and 1000-cps modulation. Excellent shielding for bridge use. 1330-A, $635.

STANDARD-SIGNAL GENERATORS

5 kc-50 Mc	up to 2 volts open-circuit output. 20c to 15 kc external, or 400c internal modulation adjustable from 0 to 80%. 1001-A, $975.
16 kc-50 Mc	4 volts open-circuit output. Incremental frequency changes possible to 0.01%. 50c to 15 kc external, or 400c and 1000c internal modulation adjustable from 0 to 100%. 805-C, $1975.
40-250 Mc, 1021-AV, $740; **250-920 Mc**, 1021-AU, $725;	1 volt out at 50 ohms. 30c to 15 kc external or 1 kc internal modulation adjustable from 0 to 50%. Both instruments use same cabinet, power supply, and modulation unit, $290. VHF Oscillator Unit $450, UHF Unit $435.

RF, VHF, UHF

0.5-50 Mc, 1211-B, $295*
50-250 Mc, 1215-B, $210*
65-500 Mc, 1208-B, $230*
180-600 Mc, 1209-BL, $260*
250-960 Mc, 1209-B, $260*
450-1050 Mc, 1361-A, $285*
900-2000 Mc, 1218-A, $465*

The best general-purpose oscillator buy available anywhere . . . compact . . . low-cost . . . covers wide frequency range with single-dial control . . . high output . . . good shielding . . . excellent stability . . . useful for all types of laboratory measurements or can be built into special assemblies . . . readily adapts to sweep operation . . . can be modulated by other signal sources.

PULSE GENERATORS

Popular general-purpose Pulser; repetition rates, 30c, 60c, and 100c to 100 kc in X1, X2, and X5 steps or 15c to 100 kc continuous with external drive. Duration, 0.2 μsec to 60,000 μsec. Output: 20v max. open circuit. 1217-A, $250*.

Pulse, Sweep, and Time-Delay Generator . . . a complete pulse system; repetition rates 0 to 250 kc, duration 25 mμsec to 1.1 sec, time delay 1 μsec to 1.1 sec, delay repetition rates 0 to 400 kc, sweep durations from 3 μsec to 120,000 μsec. 1391-B, $2025.

Time-Delay Generator; two independent delay circuits: 0 to 1.1 sec, and 0.5 μsec to 0.5 sec; can be combined for a total delay of 1.6 sec, or used independently as a coincidence circuit for producing pulse bursts. 1392-B, $1095.

SPECIAL-PURPOSE GENERATORS

Random-Noise Generator; 5c to 5Mc broadband noise source with up to 3v output. 1390-B, $295.

Time/Frequency Calibrator; compact secondary frequency standard with fixed outputs at 10 Mc, 1 Mc, 100 kc, and 10 kc; harmonics usable to 1000 Mc. Short-term accuracy after standardization is 2 parts in 10^7. 1213-D, $310*.

Standard-Frequency Oscillator; the "heart" of the G-R Frequency Standard. A 5-Mc crystal oscillator with a short-term stability of better than 1 part in 10^{10} per minute, as measured with 1-second samples. 1113-A, $1550.

Klystron Oscillator; compact microwave source covers range from 2.7 to 7.46 Gc (depending on klystron used). Internal 1-kc square wave modulation; may be pulse or frequency modulated from external source. 1220-A, $235* (less klystron).

Circle 45 on Inquiry Card

*Unit Power Supply required; $50 extra.

Write for Complete Information

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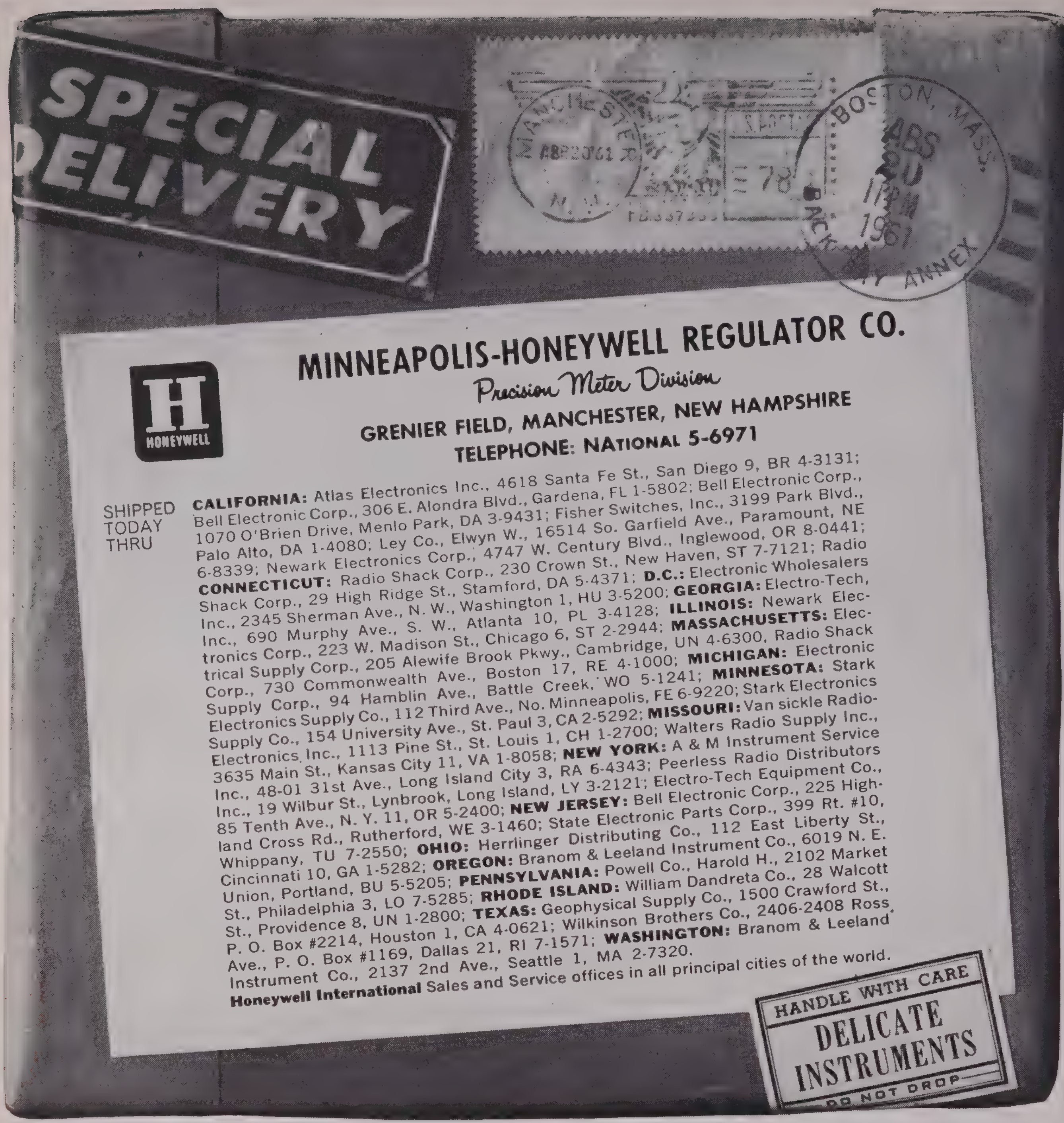

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GRENIER FIELD, MANCHESTER, NEW HAMPSHIRE
TELEPHONE: NATIONAL 5-6971

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Honeywell
Precision Meters

THE *Newest* Hermetically Sealed CAPACITOR SHAPE for TRANSISTOR CIRCUITRY

- Extremely small size provides maximum capacity per unit of chassis area.
- Ideal alternate for axial lead tubulars when space and weight is critical.
- Meets all MIL-SPEC. environmental requirements.

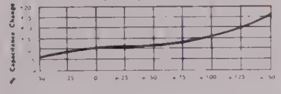
This rugged, dependable 50 Volt series was developed **specifically** for military applications. It combines the thin, flat shape of popular Good-All instrument grade 601PE capacitors with a hermetically sealed metal case of oval cross-section.

SPECIFICATIONS

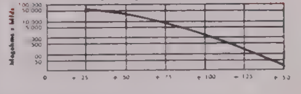
Winding Construction — Extended foil (non-inductive) MYLAR* Dielectric.
CASE —Metal enclosed, Hermetically sealed.
Temperature Range — —55°c to +125°c at full rated voltage.
Life Test — 250 hours at 125% of rated voltage and 125°c.
Vibration — Meets all requirements of specifications MIL-C-25C and MIL-C-19978A.
Temperature and Immersion Cycling, and Moisture Resistance — Meets all requirements of specifications MIL-C-25C and MIL-C-19978A.
Insulation Resistance — Greater than 75,000 megohms when measured at 100 volts D.C. at 25°c for a maximum of 2 minutes.
Capacity Tolerance — Available to ±20% ±10% ±5%.

The 605 is capable of being produced to **HIGH-RELIABILITY** specifications comparable to MIL-C-14157 and MIL-C-26244(USAF)

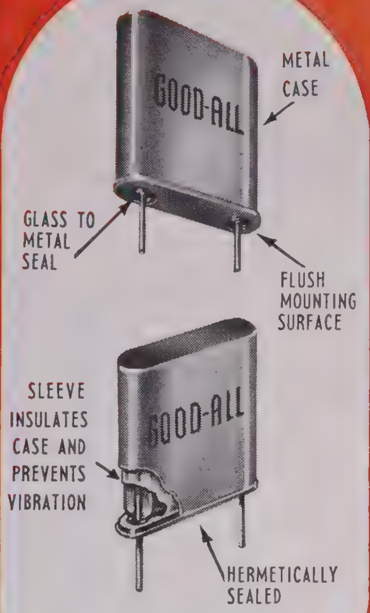
Capacitance Change vs. Temperature



Insulation Resistance vs. Temperature



*Du Pont's Trademark for Polyester Film

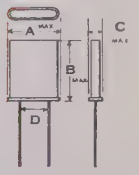


605 SERIES CAPACITORS

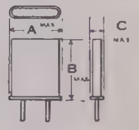
50 VOLT DIMENSIONS

CAP. MFD	A	B	C	D
.01	.426	.534	.176	.200
.022	.426	.534	.176	.200
.033	.560	.575	.235	.300
.047	.560	.575	.235	.300
.068	.560	.575	.235	.300
.10	.760	.575	.355	.500
.15	.760	.575	.355	.500
.22	.760	.790	.355	.500
.33	.760	.790	.355	.500

CASE VARIATIONS



TYPE 605
Available only in values (.01 to .068)



TYPE 605P
Available only in values (.10 to .33)

Write for detailed literature

Good-All CAPACITORS

Available at Authorized Distributors

GOOD-ALL ELECTRIC MFG. CO.
A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.
OGALLALA, NEBR.

Circle 25 on Inquiry Card

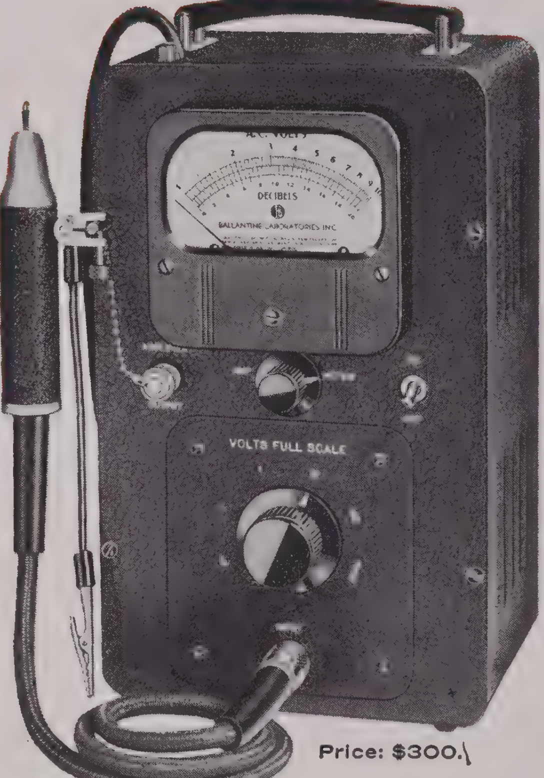
Measures 1 mv to 1000 v from

15 cps to 6 mc

BALLANTINE WIDE-BAND SENSITIVE VOLTMETER

Model 314

gives you these advantages:



Price: $300.

- Same accuracy and precision at ALL points on a logarithmic voltage scale and a uniform DB scale: 3% to 3 mc; 5% above.
- Only ONE voltage scale to read with decade range switching.
- Probe with self-holding connector tip enables measurements to be made directly at any point of circuit.
- High input impedance of 11 megohms shunted by 8 pf insures minimum loading of circuit.
- Can be used as 60 DB video pre-amplifier.

For 8 years this has been a widely-used instrument in the laboratory and for quality control

Write for brochure giving many more details

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Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES.

Letters to the Editor

(*Continued from page* 55)

Cues for Broadcasters

Editor, ELECTRONIC INDUSTRIES:

Congratulations on your June issue that contains the references and directory. I feel this is the most complete yet and we have already been using it, to quite some extent.

I would like to know if it would be possible to get a complete catalog of all of the "Cues for Broadcasters" that has been printed? If you can not obtain a bound catalog, inform me as how to obtain individual copies of each month's issue.

I feel sure that you could sell these to almost every engineer in the broadcast industry. Please let me hear from you as soon as possible. Thank you very much.

Charles G. Rapp
Chief Engineer
K C G M, Columbia, Missouri

(And the answer)

Dear Mr. Rapp:

You asked if "Cues for Broadcasters" were available in a complete booklet form. The answer unfortunately, is "No, they are not." They are not available in any "grouped" form whatever.

However, the individual items listed in our June "Director & All Reference Issue" are available as photostats. A photostat of the page that the item of interest appears on can be made. There is a service charge of 75¢ for each item requested. Many times other "Cues" will have appeared on the same page as the desired item. These are a bonus.

When ordering "Cues for Broadcasters," please address your orders to our Readers Service Department and include the title, year and month of the "Cue" along with a check or money order.

The Editors,
Electronic Industries

Filing Technical Articles

Editor, ELECTRONIC INDUSTRIES:

Will you please send me a reprint of your article "A Filing System For Technical Articles."

I am a tyro as a librarian (and typist) so the following suggestions may be antique. We find them convenient.

1. ASTIA reports are filed in a drawer—numerically. Card cross file—by subject.

2. Technical reports by originating laboratories. Cross card file—subject.

3. "The little something to be desired"—a file clerk strong enough to make up the different minds of *each*

(*Continued on page* 66)

Circle 48 on Inquiry Card

NEW!
SYLVANIA
2N781
2N782
epitaxial
GERMANIUM
mesas

• SYLVANIA 2N781

...world's fastest PNP germanium switch!

CONDITIONS	MAX.
$V_{BE(0)} = 0.5$ V; $I_{B(1)} = -1$ mA	$t_d + t_r$ 60 nsec
$V_{CC} = -3.5$ V; $R_C = 300$ Ohms	t_s 20 nsec
$I_{B(2)} = 0.25$ mA	t_f 50 nsec

...features unusually low V_{CE} (sat)

CONDITIONS	MAX.
$I_C = -10$ mA, $I_B = -1$ mA	−0.16 V
$I_C = -100$ mA, $I_B = -10$ mA	−0.25 V

SYLVANIA 2N781 – a remarkable advance in epitaxial mesa techniques — is a superior switching device featuring speeds previously unattainable with a germanium transistor. Too, it provides exceptionally low saturation voltage at all current levels.

SYLVANIA 2N782, electrically similar to the *2N781*, is specifically designed for service where high speed switching, low saturation voltage and *economy* are prime design requirements.

SYLVANIA 2N781, 2N782, utilize the TO-18 package with the collector internally tied to the case. Both are products of highly automated Sylvania manufacturing techniques and possess exceedingly uniform electrical characteristics.

ABSOLUTE MAX. RATINGS (AT 25°C)

	2N781	2N782	UNIT
Collector to Base Voltage	−15	−12	V
Collector to Emitter Voltage	−15	−12	V
Emitter to Base Voltage	−2.5	−1.0	V
Collector Current	100	100	mA
Power Dissipation (free air)	150	150	mW
Power Dissipation (case at 25°C)	300	300	mW
Storage Temperature	−65 to +100	−65 to +100	°C
Junction Temperature	+100	+100	°C

ELECTRICAL CHARACTERISTICS (AT 25°C)

Symbol	Conditions	2N781 Min.	2N781 Max.	2N782 Min.	2N782 Max.	UNIT
BV_{CBO}	$I_c = -100\ \mu A,\ I_E = 0$	−15	—	−12	—	V
BV_{EBO}	$I_E = -100\ \mu A,\ I_C = 0$	−2.5	—	−1.0	—	V
BV_{CES}	$I_c = -100\ \mu A,\ V_{BE} = 0$	−15	—	−12	—	V
h_{FE}	$I_c = -10$ mA $V_{CE} = -0.22$ V	25	—	—	—	
h_{FE}	$I_c = -10$ mA $V_{CE} = -0.25$ V	—	—	20	—	
V_{BE}	$I_c = -10$ mA, $I_B = 0.4$ mA	−0.34	−0.44	−0.34	−0.50	V
I_{CBO}	$V_{CB} = -5$ V, $I_E = 0$	—	−3.0	—	−3.0	μA
V_{CE} (Sat.)	$I_c = -10$ mA, $I_B = -1$ mA	—	−0.16	—	−0.20	V
	$I_c = -100$ mA, $I_B = -10$ mA	—	−0.25	—	−0.45	V
$t_d + t_r$	$V_{BE(o)} = 0.5$ V, $I_{B(1)} = -1$ mA	—	60	—	75	nsec
t_s	$V_{CC} = -3.5$ V, $R_c = 300$ ohms	—	20	—	35	nsec
t_f	$I_{B(2)} = 0.25$ mA	—	50	—	75	nsec

IN STOCK NOW! For immediate delivery call your Sylvania Franchised Semiconductor Distributor or contact your Sylvania Sales Engineer. Technical data available from Semiconductor Division, Sylvania Electric Products Inc., Dept. 199, Woburn, Mass.

SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

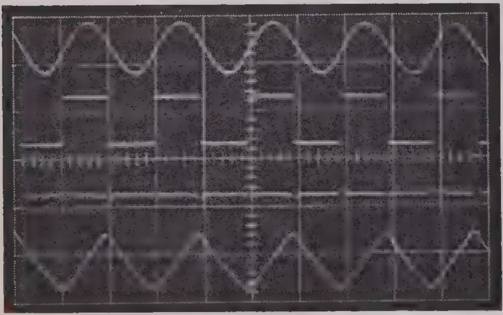
GENERAL SYSTEM

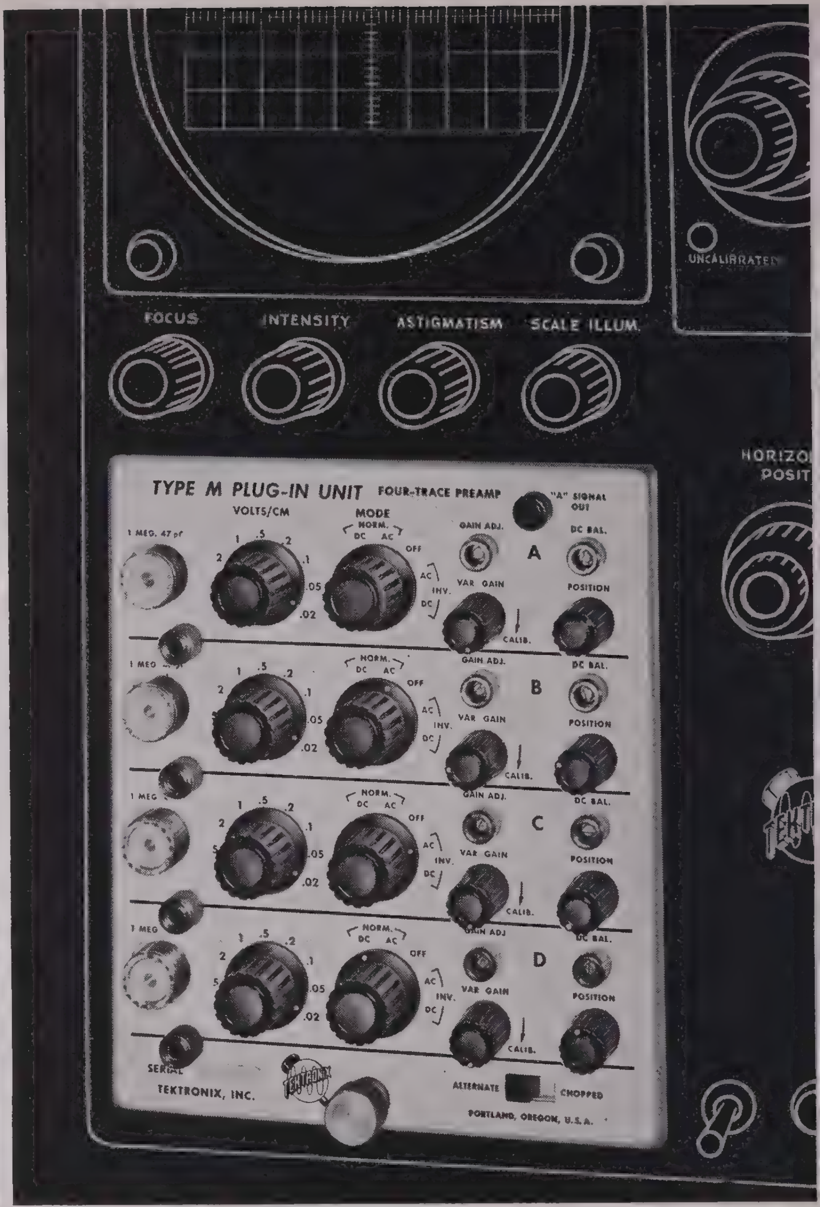
NEW

4-TRACE

PREAMPLIFIER

for Tektronix Oscilloscopes that accept letter-series plug-in units





TYPE M UNIT Seventeenth in the letter–series of plug-in units, the new Type M Unit adds multiple-trace displays to the wide range of applications possible with your Tektronix oscilloscope.

With a Type M Unit, you can observe up to four signals—either separately, or in any combination.

Independent controls for each amplifier channel permit you to position, attenuate, invert input signals as desired.

Other convenient preamplifier features—such as triggered or free-running electronic switching . . . ac-coupling or dc-coupling . . . and, after initial hookup, little or no cable switching—ideally suit the new Type M Unit for multiple-trace presentations in the laboratory or in the field.

For more information about this new 4-Trace Preamplifier, please call your Tektronix Field Engineer.

CHARACTERISTICS

Operating Modes—Any combination of one to four channels electronically switched—at the end of each sweep or at a free-running rate of about 1 mc (1 μsec width samples). Or each channel separately. *Channel Sensitivity*—20 mv/cm to 10 v/cm in 9 calibrated steps. Continuously variable uncalibrated between steps, and to 25 v/cm. *Channel A Signal*—available on front panel for optimum triggering in some applications. *Frequency Response and Risetime*—With Type 540-Series and Type 550-Series Oscilloscopes dc to 20 mc, 17 nsec. With Type 531A, 533A, 535A Oscilloscopes dc to 14 mc, 25 nsec. *Constant Input Impedance*—at all attenuator settings.

Type M Plug-in Unit **$455.00**
f.o.b. factory

Tektronix, Inc. *P. O. BOX 500 · BEAVERTON, OREGON / MItchell 4-0161 · TWX—BEAV 311 · Cable: TEKTRONIX*

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In Europe please contact Tektronix International A.G., Terrassenweg 1A, Zug, Switzerland, Phone (042) 4-91-92, for the address of the Tektronix Representative in your country.

Circle 53 on Inquiry Card

Circle 50 on Inquiry Card ⟶

2 NEW PRODUCT ADVANCES FROM Transitron

ACTUAL SIZE

TMD-914 and TMD-916 DIFFUSED SILICON MICRODIODES MICRO-EQUIVALENTS of the 1N914 and 1N916

Duplicating the specifications of the popular 1N914 and 1N916, these microminiature very fast switching silicon diodes offer low capacitance and are designed for use in extremely high speed transistorized computer circuitry. Their durable construction in an all-glass package features TRUE hermetic sealing and a unit capable of providing long-term reliability under extreme environmental conditions.

Recovery time: 0.004 micro-second.

SPECIFICATIONS AT 25°C

	TMD-914	TMD-916
Maximum Forward Voltage at 10mA	1 Volt	1 Volt
Maximum Inverse Current at 20V	.025 μA	.025μA
Minimum Inverse Voltage at 100μA	100 Volts	100 Volts
Maximum Capacitance at 0 Volts	4 μμF	2 μμF

For further information, write for Bulletin PB-71C.

ACTUAL SIZE

6.3 VOLT CERTIFIED SILICON VOLTAGE REFERENCES

Now, for the first time in the industry, silicon voltage references that have exhibited voltage stabilities as low as ±.002% for 1000 hours are being CERTIFIED and offered by Transitron. These significant features are associated with each unit:

- Actual readings recorded periodically over 1000 hours included with each certification document.
- Serialization of units for convenient reference to their production and life test histories at Transitron.

Manufacturers of missiles and precision instruments who require a stable voltage reference of small size and weight may look to Transitron for these references which are certified at point of purchase.

Type	Certified* Voltage Stability (%)	Voltage Range at $I_Z = 7.5$mA at 25°C (Volts)		Temperature Stability Maximum Voltage Change (+25°C to +100°C) at $I_Z = 7.5$mA (Volts)	Maximum Dynamic Resistance at $I_Z = 7.5$mA at 25°C (Ohms)
		Min.	Max.		
1N3501	±0.01	6.2	6.5	±0.006	12
1N3502	±0.01	6.2	6.5	±0.003	12
1N3503	±0.005	6.2	6.5	±0.006	12
1N3504	±0.002	6.2	6.5	±0.006	12

*Voltage References certified for voltage stability observed during 1000 hours operation.

For further information, write for Bulletin TE-1352F-1.

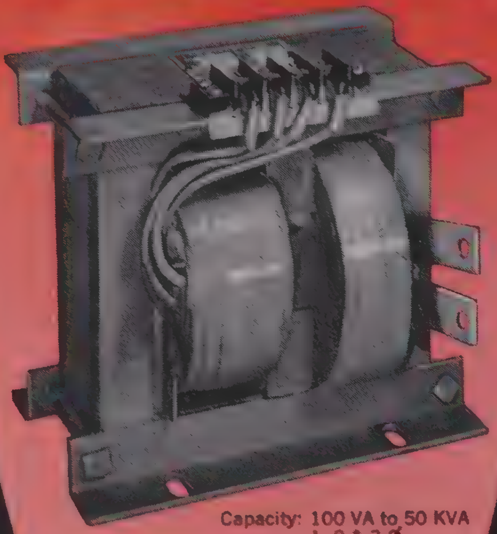
Transitron

electronic corporation
wakefield, melrose, boston, mass.

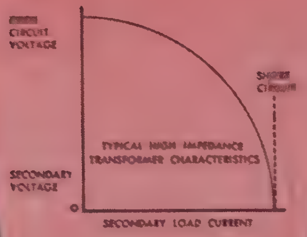
SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U.S.A. AND EUROPE • CABLE ADDRESS: TRELCO

For quantities 1-999 call your nearest Transitron Industrial Distributor.

DESIGNED FOR CURRENT LIMITING APPLICATIONS



Capacity: 100 VA to 50 KVA
1, 2 & 3 Ø



NWL HIGH IMPEDANCE TRANSFORMER

Fits any application where current limiting is needed such as:

- large electronic filament tubes
- industrial lamps
- arc welders
- high impedance tube circuits
- rectifiers
- short circuit limiting

Each NWL unit is thoroughly tested and must meet all customer requirements before shipment. We shall be pleased to quote you according to your individual requirements.

NWL
ESTABLISHED 1920
NEMA

Nothelfer
SAY: NO—TEL—FER

NOTHELFER WINDING LABORATORIES, INC., P. O. Box 455, Dept. EI-9, Trenton, N. J.
(Specialists in custom-building)

Circle 51 on Inquiry Card

Letters to the Editor

(*Continued from page 62*)

engineer. These same engineers have such active inventive minds that they let them run out of bounds on other categories. Plus very little memory for previous statements made by them.

Margaret D. Brubaker, Librarian
Research Laboratory

Litton Industries
Electron Tube Division
960 Industrial Road
San Carlos, California

More on Vacuum Tubes

Editor, ELECTRONIC INDUSTRIES:

I wish to compliment you on your very excellent publication. I have found it to contain many articles of great value. However, there are enough of us still using vacuum tubes that a series of articles on vacuum tube circuit design would be well received.

Earl W. Smith
Electronics Engineer

Elliott Company
Ridgway, Pa.

Ed: We are well aware that vacuum tubes are still very much with us. In our 1961 June All-Reference Issue, for instance, beginning on page 91, there is a 7-page summary of the new tubes released during the past year.

RFI Series

Editor, ELECTRONIC INDUSTRIES:

In conducting tests and investigative programs dealing with radio interference, it is necessary for me to keep abreast of current products and developments employed in the reduction of interference.

On several occasions I have had the opportunity of reading through various copies of ELECTRONIC INDUSTRIES received by other personnel of this company. I would appreciate being placed on your mailing list for receipt of forthcoming issues, since there are many articles which I would like to add to my library.

If at all possible, I would appreciate your sending me the following back issues: March 1960; April 1960; May 1960; Oct. 1960; March 1961; April 1961; May 1961.

I realize the demand for ELECTRONIC INDUSTRIES is great, and that you may be unable to provide some of the back issues requested. You can be sure that whatever you can send will be very much appreciated.

Cliff Maulsby
Int. Engr.

Admiral Corporation
3800 Cortland Street
Chicago 47, Ill.

To Contractors and Subcontractors on U. S. Government Projects

Western Electric offers the high reliability JAN 2N1195 Transistor

The JAN 2N1195 is a diffused base germanium mesa transistor for video, radio frequency, and switching applications. This transistor is not selected from a broad distribution of electrical values. Laureldale's controlled manufacturing conditions assure the circuit designer of uniform lot-to-lot transistor characteristics.

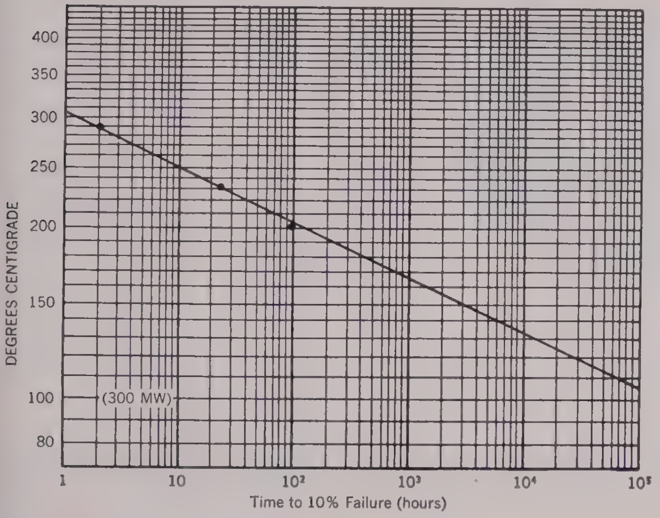
MAXIMUM RATINGS AT 25°C

Power dissipation in free air	225 MW*
Collector breakdown voltage	30 Volts
Emitter breakdown voltage	1 Volt
Maximum junction temperature	100°C

*Conservative—300 MW capability has been established

TYPICAL ELECTRICAL CHARACTERISTICS

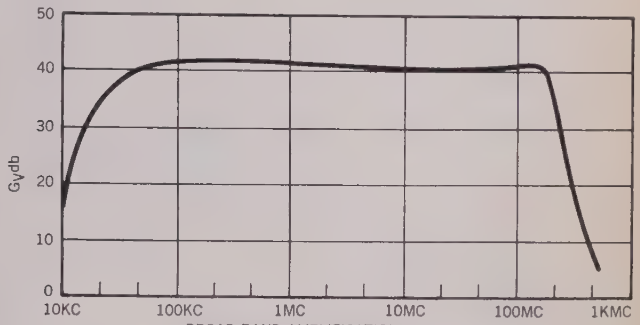
$f_{\alpha b}$	750 MC
$R_e h_{ie}$ (250 MC)	55 Ohms
C (dep)	1.2 $\mu\mu f$
h_{fb} (1000 cps)	98



RELIABILITY

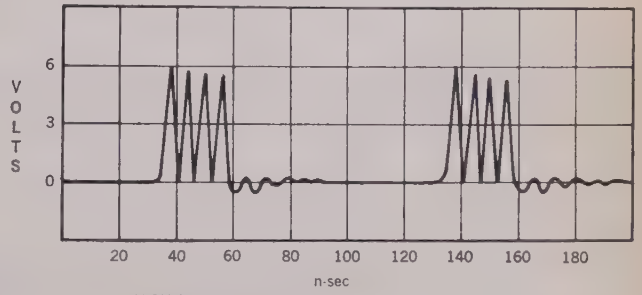
Lot-by-lot life tests have established a failure rate of less than 0.1% for 1000 hours at 100° C.

This chart illustrates results obtained at high storage temperatures and demonstrates the inherent reliability of the JAN 2N1195 transistor.



BROAD BAND AMPLIFICATION

Insertion voltage gain of 8-stage amplifier using two JAN 2N1195's as output transistors.



HIGH SPEED SWITCHING

Output of 160 MC multiplexer using JAN 2N1195 transistors.

The JAN 2N1195 transistor can be purchased in quantity from Western Electric's Laureldale Plant. For technical information, price, and delivery, please address your request to Sales Department, Room 105, Western Electric Company, Incorporated, Laureldale Plant, Laureldale, Pa. Telephone – Area Code 215 – WAlker 9-9411.

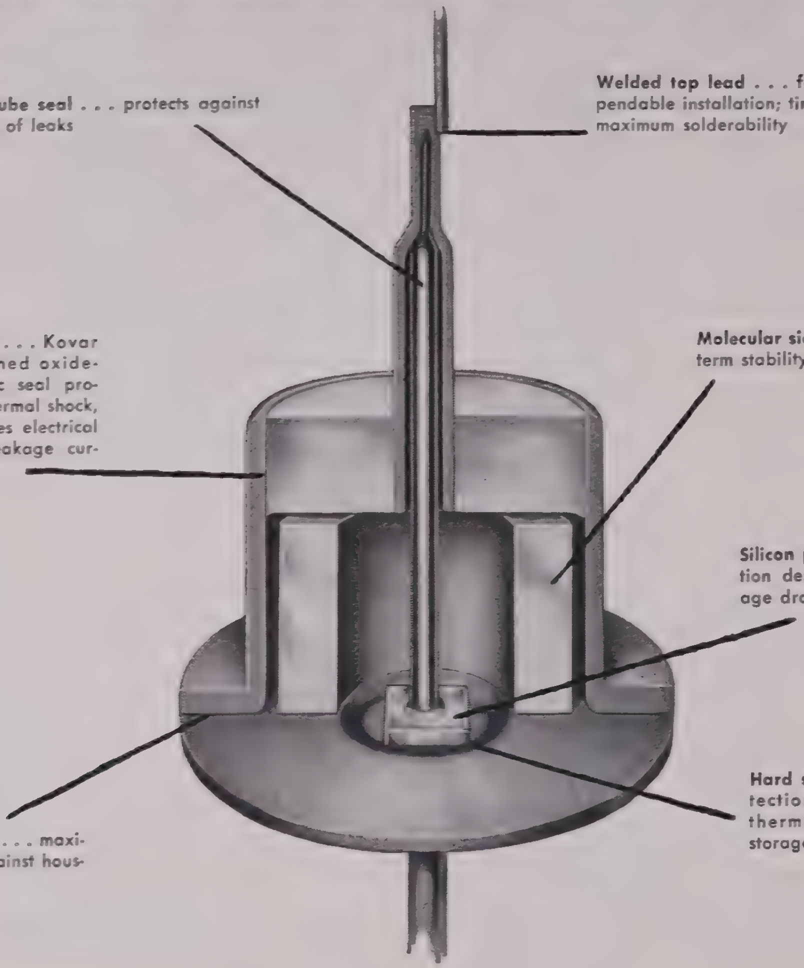
Western Electric

MANUFACTURING AND SUPPLY BELL SYSTEM UNIT OF THE BELL SYSTEM

Circle 49 on Inquiry Card

HERE'S THE INSIDE STORY OF

General Electric low current



Welded tube seal . . . protects against possibility of leaks

Welded top lead . . . for easy, dependable installation; tin dipped for maximum solderability

Hermetic seal . . . Kovar metal to matched oxide-bonded ceramic seal protects against thermal shock, cycling; enhances electrical stability, low leakage current

Molecular sieve . . . a "getter" for long term stability

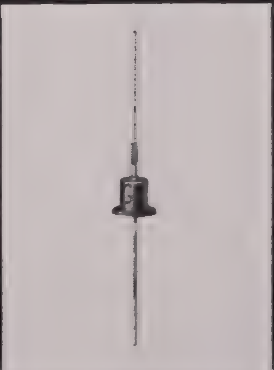
Silicon pellet . . . highly efficient junction design minimizes forward voltage drop

Hard soldered joint . . . maximum protection against failures caused by thermal fatigue, high temperature storage

Welded main seal . . . maximum protection against housing leaks

GERMANIUM RECTIFIERS UP TO 1200 MA • UP TO 400 PRV

11 types, including MIL approved units, recognized as the industry standard for high reliability. Features include extremely low forward resistance, high back resistance, and transient PRV ratings for safer applications.

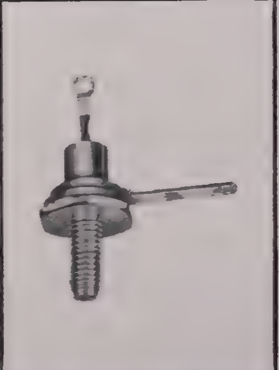


LEAD MOUNTED SILICON RECTIFIERS UP TO 750 MA • UP TO 1000 PRV

54 types, including MIL approved units, featuring transient PRV ratings, maximum forward conductance at high operating temperatures, very low leakage and unusual freedom from thermal fatigue.

STUD MOUNTED SILICON RECTIFIERS UP TO 1.5 AMPS • UP TO 1000 PRV

50 types, including MIL approved units. Most types identical to the popular lead mounted units, except for the stud mounting. Transient PRV ratings, high reliability.



INSULATED STUD SILICON RECTIFIERS UP TO 1.5 AMPS • UP TO 600 PRV

6 types, identical to the popular stud mounted 1N115-1N1120 series, except that the stud is electrically insulated from the junction. Transient PRV ratings.

SILICON ZENER DIODES ONE WATT AXIAL LEAD

28 types, including A and B versions, featuring low junction temperatures under operating conditions, cool operation for improved characteristics and long life. All-welded package for reliability under extreme environmental conditions.

rectifiers and Zener diodes

An average of 16 separate life, electrical, mechanical and environmental tests prove out the quality that has been built into General Electric low current rectifiers and zener diodes. The use of "getters", the finest hermetic seal available, hard soldered joints, and welded main and tube seals are only a few of the reasons they test out so well. Silicon rectifier type 1N538, for example, was put through torturous life test studies over a period of *10,000 hours* at maximum temperature, current and PRV . . . and came through with a 99% survival percentage.

For complete technical information, just call your Semiconductor Products District Sales Manager. Or write Rectifier Components Department, Section 24I26, General Electric Company, Auburn, New York. In Canada: Canadian General Electric, 189 Dufferin Street, Toronto, Ont. Export: International General Electric, 150 E. 42nd Street, N.Y. 17, N.Y.

For fast delivery of selenium, germanium, and silicon rectifiers at factory-low prices, see your authorized G-E distributor

Progress Is Our Most Important Product

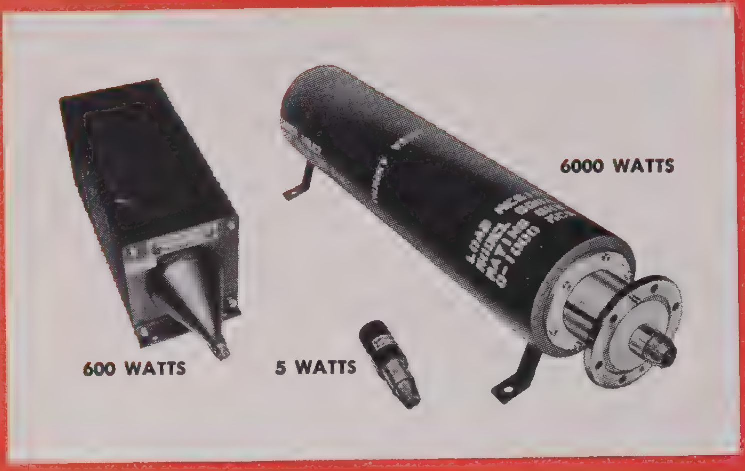
GENERAL ELECTRIC

Circle 68 on Inquiry Card

MicroMatch®

RF LOAD RESISTORS
COVER THE RANGE:

TO 6000 WATTS AND 3000 MCS.



MicroMatch RF Load Resistors provide the virtually reflectionless terminations needed for accurate RF power measurement. They serve many useful purposes as non-radiating RF power absorbers, particularly in lieu of antenna systems during the measurement and alignment phase of transmitter operation.

Other useful functions are in conjunction with feed-through wattmeters to form excellent absorption-type wattmeters, and as a load for side-band elimination filters or high power directional couplers.

SPECIFICATIONS		RF LOAD RESISTORS	
MODEL NO.	FREQUENCY RANGE (mcs)	RF POWER DISSIPATION (watts)	RF CONNECTORS
601	0-3000	5	N, C or BNC
603	0-3000	20	N, C or BNC
633	0-3000	50	N, C or HN
634	0-3000	150	N, C or HN
635	0-3000	200	N, C or HN
636	0-3000	600	N, C or HN
638	0-2000	6000	3⅛" flange

Many other special models have been designed and manufactured to meet your particular space and input connection requirements.

For more information on RF Loads, Directional Couplers, Tuners, and RF Wattmeters, write:

M. C. JONES ELECTRONICS CO., INC.

MC Jones

185 N. MAIN STREET, BRISTOL, CONN.
SUBSIDIARY OF THE Bendix CORPORATION

Personals

Charles S. Mertler—named Engineering Vice President, Stevens Mfg. Co., Inc., Mansfield, Ohio.

Dr. Raymond M. Wilmotte — appointed Project Manager of the Relay experimental communications satellite, Radio Corp. of America.

Dudley H. Campbell—named Chief Engineer, Control & Switch Dept., Stackpole Carbon Co., St. Marys, Pa.

James M. Cunnien—appointed Director of Engineering, Minneapolis-Honeywell's Precision Meter Div., Manchester, N. H.

Benjamin Topas—appointed to the engineering staff of International Rectifier Corp., El Segundo, Calif.

B. Topas

Dr. E. G. Witting

Dr. Edward G. Witting — named Manager of Research and New Products, Cannon Electric Co., Los Angeles, Calif.

Keith Bennett—named Chief Industrial Engineer, Burroughs Corp., Detroit, Mich.

Everett Munson—appointed Chief Engineer of Central Transformer Co., Chicago, Ill.

Kurt Celms—named Chief Project Engineer, Standard Systems Corp., Long Island City, N. Y.

Warren R. Yuenger — named Research Scientist, Ling-Altec Research Div., Ling-Temco Electronics, Inc., Anaheim, Calif.

Leo A. Nadler—to the post of Senior Project Engineer, PRD Electronics, Inc., Brooklyn, N. Y.

Dr. D. M. Gillies—appointed Director of Research, Union Carbide Metals Co., Div. Union Carbide Corp., New York, N. Y.

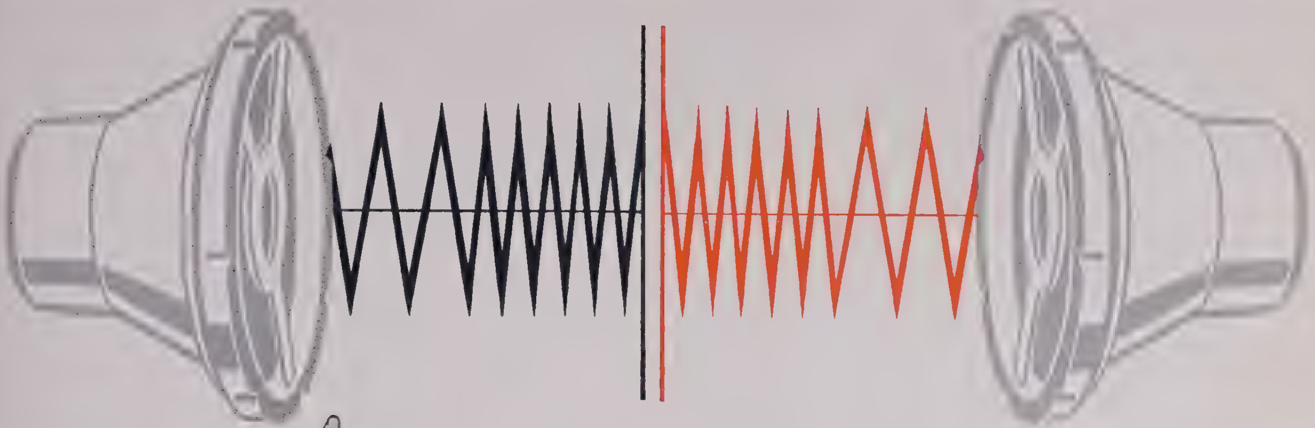
James F. Forney—appointed Manager of Information Processing, General Electric Co.'s Electronics Laboratory, Syracuse, N. Y.

Daystrom, Inc., Military Electronics Div. Archbald, Pa., announces the following appointments: **Pat Minervini**—Engineering Manager; **Bernard Plevyak**—Chief Product Engineer; and **Donald S. Taylor**—Development Engineer.

(*Continued on page* 76)

Circle 55 on Inquiry Card

ELECTRON TUBE NEWS from SYLVANIA



New! Sylvania-6JK8 especially designed for FM Tuners for Stereo Multiplex

Features strap frame grid! Provides high signal-to-noise!

Sylvania-6JK8, double triode, opens new design possibilities for high gain, low noise performance in a low-cost, compact FM tuner. 6JK8 combines a strap frame grid RF amplifier and an oscillator-mixer in a T-6½ envelope with miniature 9-pin circle. It enables the design of a simplified circuit capable of better than 40db quieting with less than 10 μVolts signal input for superb multiplex performance. Equally significant, 6JK8 and its associated family – 8JK8, 17JK8–cost less than two single triodes of comparable performance.

TYPICAL CHARACTERISTICS–6JK8
Ef – 6.3V If – 400mA

	Triode #1	Triode #2*	Units
Eb	150	135	V
Ec_1	–1	–1.2	V
Ib	5.3	11.5	mA
Gm	6800	14,500	μmhos
Mu	50	70	

*Utilizes Strap Frame Grid

SYLVANIA 10-PIN TYPES FOR 1-TUBE FM TUNER FRONT ENDS

Sylvania-6/17C9 combines two high performance sharp-cutoff tetrodes in a T-6½ envelope. Tenth pin enables separate connections for cathodes and the use of effective shielding to reduce undesirable oscillator signal radiation. They are designed for VHF service as an RF amplifier and autodyne mixer.

Sylvania SR-2946A, triple triode in a T-6½ bulb. Ten-pin base provides excellent isolation, heater from cathodes, facilitating circuit design for series string operation. SR-2946A provides the combined functions of RF amplifier, oscillator-mixer, AFC control.

IMPROVED SYLVANIA TYPES FOR SUB-CARRIER GENERATORS

Sylvania-12AT7, 12AU7A, 12AX7A are improved versions of these popular types featuring low hum, noise and microphonics and offering amplification factors of 62, 20, 100 respectively.

For further information, contact your Sylvania Sales Engineering Office. For technical data on specific types, write Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

How high is the confidence level of the components in your design?

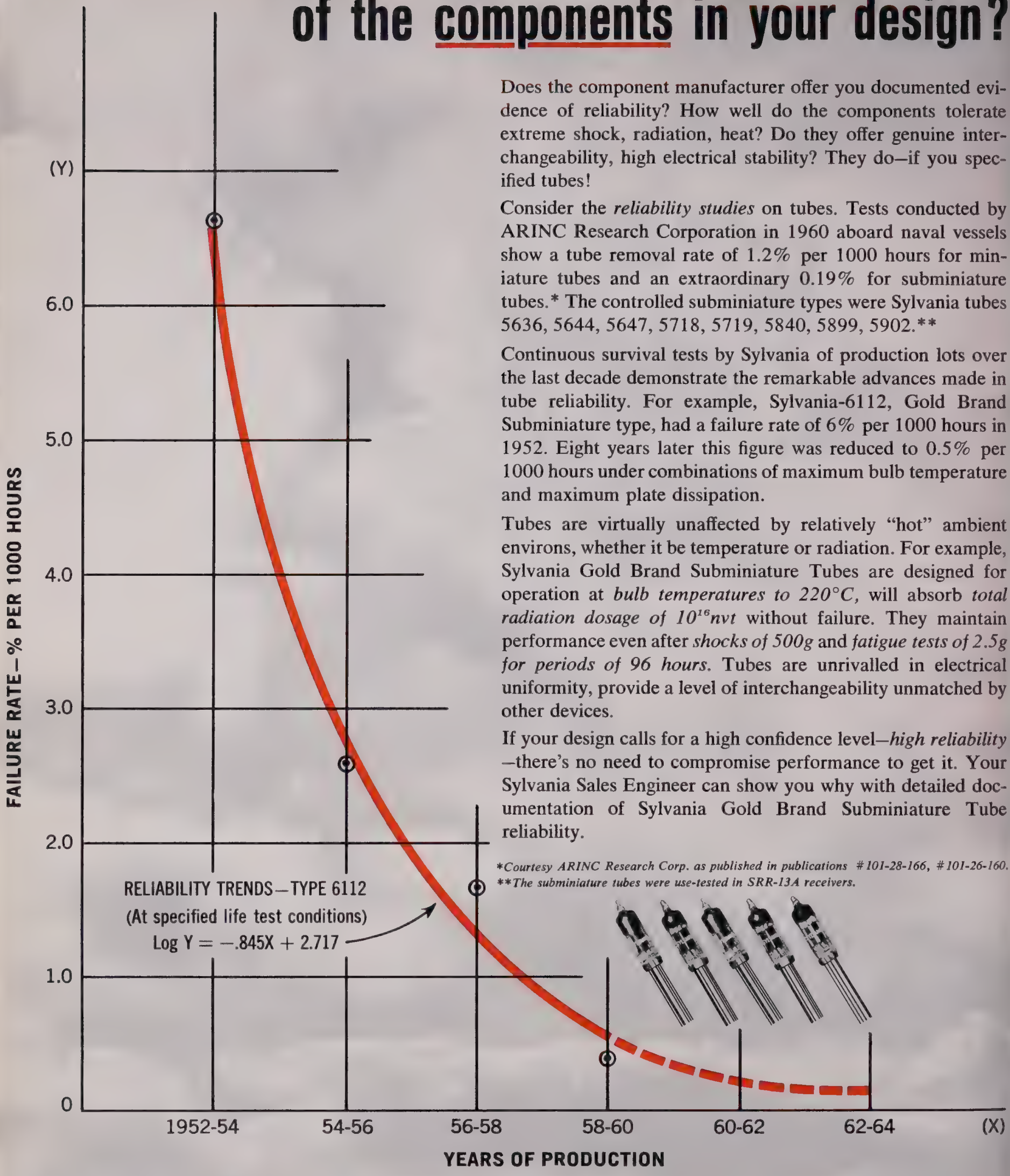
Does the component manufacturer offer you documented evidence of reliability? How well do the components tolerate extreme shock, radiation, heat? Do they offer genuine interchangeability, high electrical stability? They do—if you specified tubes!

Consider the *reliability studies* on tubes. Tests conducted by ARINC Research Corporation in 1960 aboard naval vessels show a tube removal rate of 1.2% per 1000 hours for miniature tubes and an extraordinary 0.19% for subminiature tubes.* The controlled subminiature types were Sylvania tubes 5636, 5644, 5647, 5718, 5719, 5840, 5899, 5902.**

Continuous survival tests by Sylvania of production lots over the last decade demonstrate the remarkable advances made in tube reliability. For example, Sylvania-6112, Gold Brand Subminiature type, had a failure rate of 6% per 1000 hours in 1952. Eight years later this figure was reduced to 0.5% per 1000 hours under combinations of maximum bulb temperature and maximum plate dissipation.

Tubes are virtually unaffected by relatively "hot" ambient environs, whether it be temperature or radiation. For example, Sylvania Gold Brand Subminiature Tubes are designed for operation at *bulb temperatures to 220°C,* will absorb *total radiation dosage of 10^{16}nvt* without failure. They maintain performance even after *shocks of 500g* and *fatigue tests of 2.5g for periods of 96 hours.* Tubes are unrivalled in electrical uniformity, provide a level of interchangeability unmatched by other devices.

If your design calls for a high confidence level—*high reliability*—there's no need to compromise performance to get it. Your Sylvania Sales Engineer can show you why with detailed documentation of Sylvania Gold Brand Subminiature Tube reliability.



**Courtesy ARINC Research Corp. as published in publications #101-28-166, #101-26-160.*

***The subminiature tubes were use-tested in SRR-13A receivers.*

EQUIPMENT SALES OFFICES

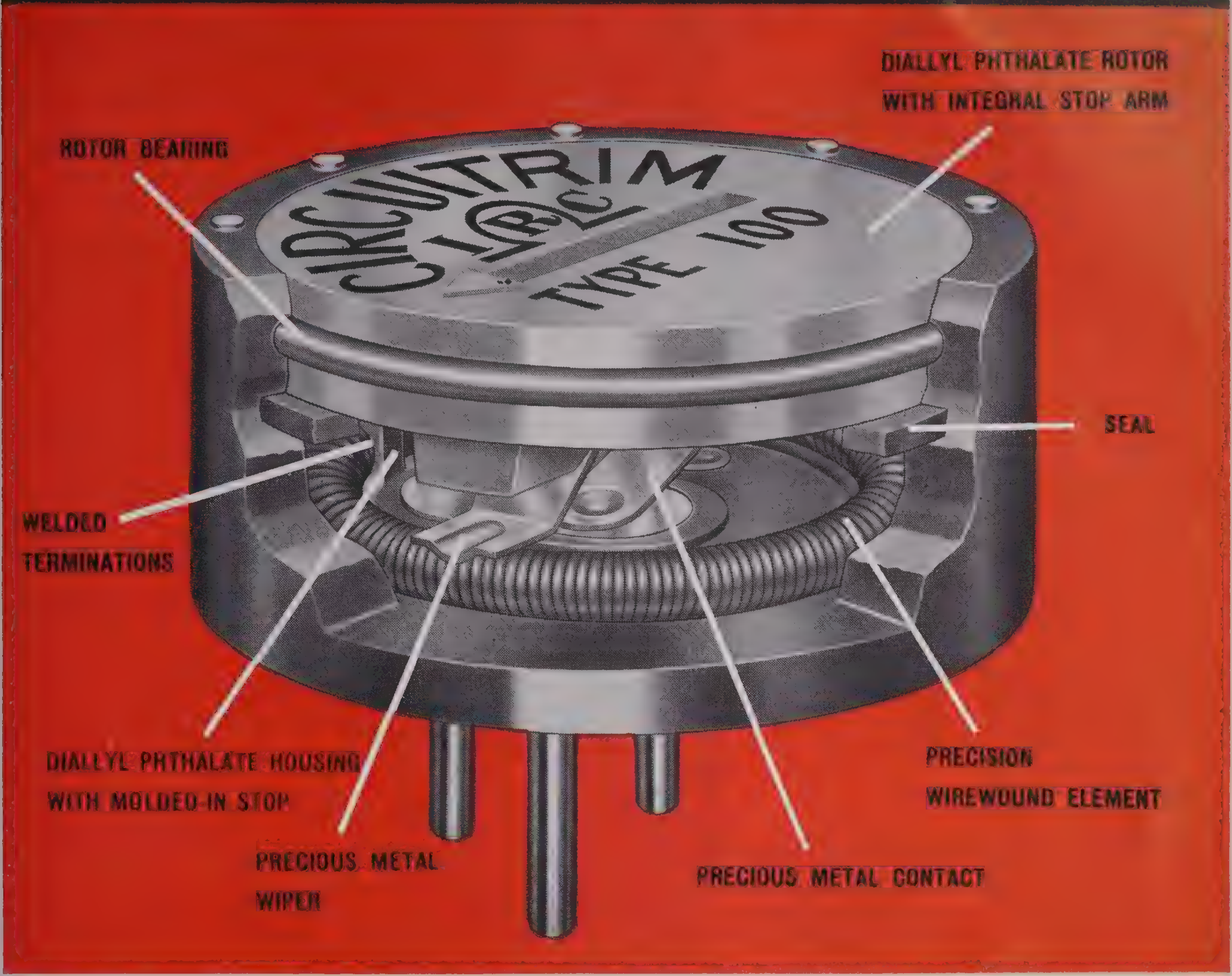
CHICAGO: 2001 N. Cornell Ave., Melrose Park, Ill., ESterbrook 9-2525; **CINCINNATI:** 411 Oak St., PLaza 1-8454; **DALLAS:** 100 Fordyce St., RIverside 1-4836; **DAYTON:** 333 W. First St., BAldwin 3-6227; **FORT WAYNE, IND.:** 4740 Coldwater Rd., T3-1145; **LOS ANGELES:** 6505 E. Gayhart St., RAymond 3-5371, **NEW YORK CITY:** 1000 Huyler St., Teterboro, N. J., ATlas 8-9884; **N.Y.-UPSTATE:** Seneca Falls, LOgan 8-5881; **ORLANDO:** Suite C, 1520 Edgewater Dr., P.O. Box 7248, Orlando, Fla., GArden 4-8245; **SAN FRANCISCO:** 1811 Adrian Rd., Burlingame, Calif., OXford 7-3500, **WASHINGTON, D.C.:** 1120 Connecticut, N.W., FEderal 7-6600; **WILMINGTON, MASS.:** 281 Main St., OLiver 8-3357.

SYLVANIA

SUBSIDIARY OF

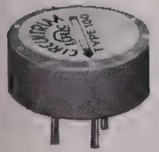
GENERAL TELEPHONE & ELECTRONICS

In PRECISION POTENTIOMETERS if it's news, expect it first from IRC


DIALLYL PHTHALATE ROTOR WITH INTEGRAL STOP ARM
ROTOR BEARING
CIRCUITRIM
IRC
TYPE 100
SEAL
WELDED TERMINATIONS
DIALLYL PHTHALATE HOUSING WITH MOLDED-IN STOP
PRECISION WIREWOUND ELEMENT
PRECIOUS METAL WIPER
PRECIOUS METAL CONTACT

EXPOSED...a new simplified trimmer design

increased reliability...added economy



The new IRC ½″ round Circuitrim trimmer with its unique mechanical design (depicted above) simplifies the complex mechanical linkage used for adjustment in most trimmers making it more reliable and less costly. This round trimmer design employs the same fine electrical assembly found in IRC's popular square trimmer. Available in twelve standard ranges from 10 ohms to 50K ohms, 1 watt. Higher power rating available.

Set it and forget it is the paramount feature of IRC's new square trimmer, made possible by an exclusive self-locking, antibacklash spiroid drive gear. Square Circuitrim has superior moisture, shock and vibration characteristics, and is interchangeable with earlier designs. Teflon leads and seals standard. Printed circuit terminals available. 10 ohms to 50K ohms, 1 watt. Write for technical bulletins. International Resistance Company, 401 N. Broad St., Philadelphia 8, Pa.

COMPLETE LINE OF PRECISION POTENTIOMETERS • STOCKED BY IRC MAJOR INDUSTRIAL DISTRIBUTORS

Standard Single and Multi-turn • Moisture Sealed and High Temperature • Hermetically Sealed • Servo Potentiometers • REVODEX 10-turn Dials

IRC

Leading supplier to manufacturers of electronic equipment

Circle 56 on Inquiry Card

NOW...count and control precisely with new decade counters from Raytheon

RAYTHEON DECADE COUNTER TUBES

TYPES	CK6909 CK6910*	CK6476* CK6802	CK6476A* CK7978*
DC Supply	450 volts	425 volts	425 volts
Anode Resistor	0.27 meg ohms	0.82 meg ohms	0.82 meg ohms
Nominal Tube Drop	235 volts	187 volts	187 volts
Cathode Resistor	24 K ohms	100 K ohms	100 K ohms
Output (Across Cathode Resistor)	15 volts	30 volts	30 volts
Speed	to 100 kc	to 5 kc	to 5 kc
Maximum voltage between Electrodes (excluding Anode)	140 volts	140 volts	200 volts

*All ten cathodes brought out independently for electrical readout.

More efficient equipment for precision counting and control of high-speed production machines can now be designed with Raytheon decade counter tubes. Because these tubes provide both visual *and* electrical readout, the functions of counting and stopping machinery at preprogrammed intervals can be combined with less circuitry and components.

The new Raytheon 13-pin CK7978 offers the advantages of small size, economical socket requirements, rugged construction, long life—and outstanding cost reductions both in lower initial purchase price and simpler circuitry requirements.

Frequency dividing, matrixing, telemetering, sampling, timing, and coding are other applications for Raytheon decade counter tubes. For full information please write: Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

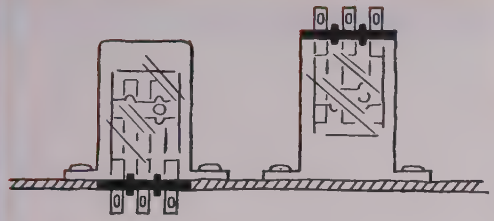
For Small Order or Prototype Requirements See Your Local Franchised Raytheon Distributor

RAYTHEON COMPANY

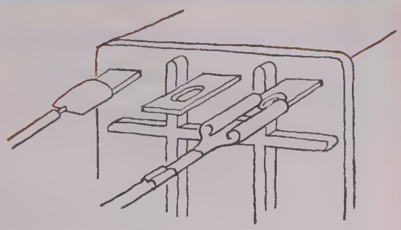
RAYTHEON

INDUSTRIAL COMPONENTS DIVISION

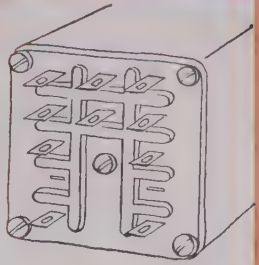
FRESH IDEAS IN RELAYS...



CHOICE of below-chassis or above-chassis connecting in plastic enclosures.



MULTI-USE terminals allow soldering, insertion in printed circuit board, and use of AMP Style 110 push-on terminals.



ALL TERMINALS on *one* panel . . . permits insertion in printed circuit board.

SPECIFICATIONS

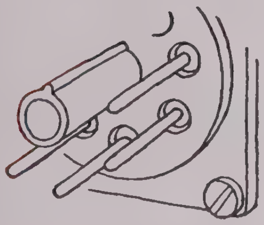
CONTACTS: *Integral with terminals;* up to 3PDT; 5 amp, 115 VAC or 32 VDC. Stationary contacts, fine silver inlay material; movable, solid fine silver.

COILS: Up to 230 VAC at 60 cps or 115 VDC.

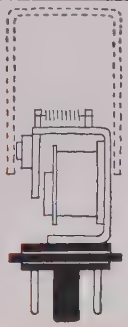
ENCLOSURES: Clear plastic.

TERMINAL PANELS: Barrier type or octal plug.

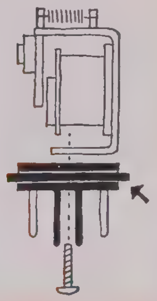
LATCHING RELAY: Available enclosed in clear plastic with plug-in mounting; or unenclosed.



OCTAL PLUG relays up to DPDT have recessed pin bases . . . meet UL spacing requirements to 150 V.



ALL ENCLOSED relays mount solidly on base . . . *not* on covers.

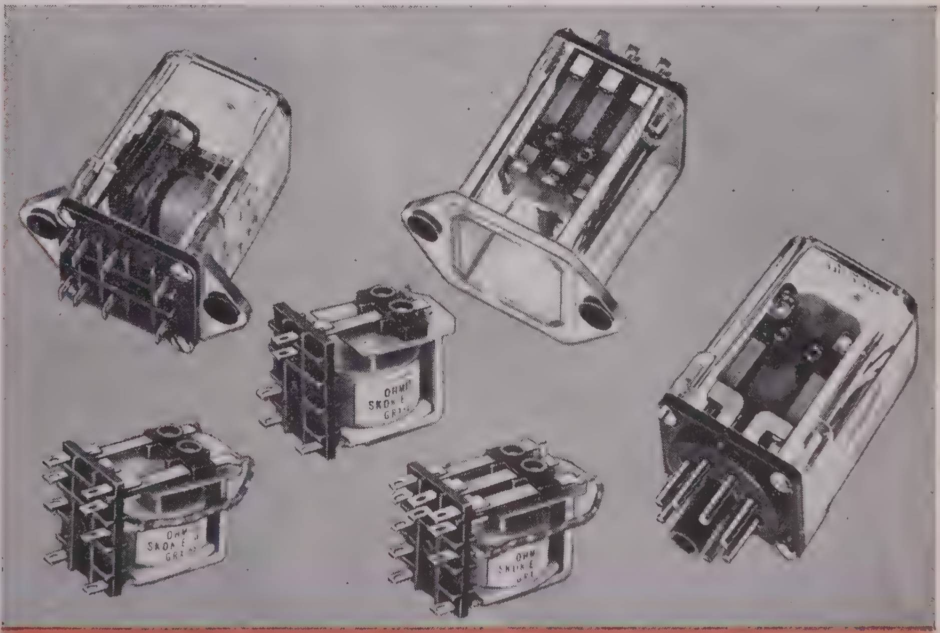


INTEGRAL plug-in base up to DPDT avoids wiring between contact terminals and pins.

OHMITE'S New "GR" Series

Stocked for Immediate Delivery From Distributors or Factory . . .

WRITE FOR BULLETIN 166

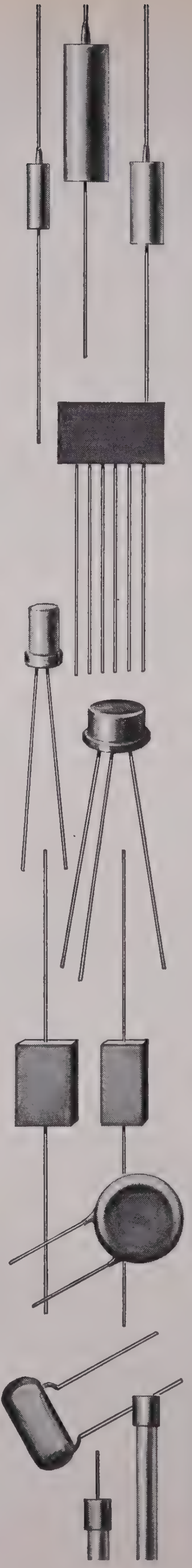


OHMITE

OHMITE MANUFACTURING COMPANY
3662 Howard Street
Skokie, Illinois

Rheostats • Power Resistors
Precision Resistors
Variable Transformers
Tantalum Capacitors • Tap Switches
Micromodules • Relays
R.F. Chokes • Germanium Diodes

← Circle 61 on Inquiry Card



PROCESS 200 AT A TIME

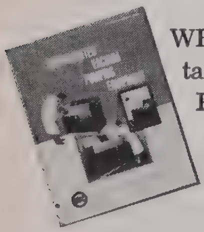
CVC 10-PORT VACUUM MANIFOLD SYSTEM

Here's a volume production system specifically designed for the super-speed evacuation, leak-checking, backfilling and sealing of small electronic components. The CVC Type PSM-110 10-Port Manifold thoroughly removes all traces of moisture and corrosive contaminants before the product is sealed off.

You can attach as many as 20 processing lines to each of the 10 Ports—process up to 200 units at once. And *fast*—because you get the lowest ultimate pressures and fastest pumping speeds of any production line system available today!

Pumping speed at each port: 2.5 liters per second. Ultimate pressure: $8x10^{-6}$ mm Hg with the basic system; $1x10^{-6}$ mm Hg with refrigeration accessories. Pump-down time is faster, too—rough-pump all 10 ports simultaneously to 100 microns in less than 2 minutes. And, accessory ovens permit bake-out temperatures to 400°C.

You can multiply production and profits with this flexible new pumping system. Ask your CVC representative.



WRITE for Bulletin 4-1 with full details on the new CVC PSM-110 10-Port Manifold.

Consolidated Vacuum Corporation

ROCHESTER 3, NEW YORK

A SUBSIDIARY OF CONSOLIDATED ELECTRODYNAMICS/BELL & HOWELL

Circle 58 on Inquiry Card

Personals

Richard F. Kruger—named Production Superintendent of Color Television, Corning Glass Works Pressware plant, Corning, N. Y.

Edward P. Farnsworth — named Senior Staff Engineer, Advanced Sciences Div., Laboratory For Electronics, Inc., Boston, Mass.

Michael T. Trainor—named Executive Engineer, Military Products Div., Adler Electronics Inc., New Rochelle, N. Y.

Charles G. Small, Sr. — appointed Chief Process Engineer, Telex/Aemco Div., Telex, Inc., Mankato, Minn.

Dr. John N. Dempsey—named Director, Research Center, Minneapolis-Honeywell Regulator Co., St. Paul, Minn.

Dr. J. N. Dempsey

R. A. Wainwright

Richard A. Wainwright — named Chief Engineer, Filter Div., Telonic Engineering Co., Laguna Beach, Calif.

Navigation Computer Corp., Norristown, Pa., announces the following appointments: **Charles R. Wiegand**—Head of Quality Control Group and new additions to the Technical Staff: **Lewis Cardy, Jr.; Dudley W. Gill, Jr.; Marvin F. Hitchcock, Jr.; David Plager;** and **Alan L. Vink.**

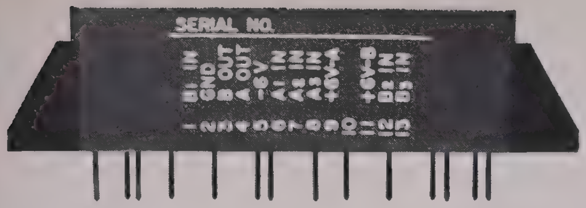
Rudolph F. Kouba—appointed to the staff of the Organic Chemistry Dept. of Tracerlab, Waltham, Mass.

Paul G. Edwards—to Head The Mitre Corp.'s Communications Dept., Bedford, Mass.

Richard W. Young — appointed to the Field Engineering Staff of the Sprague Electric Co., North Adams, Mass.

Lenkurt Electric Co., Inc., San Carlos, Calif., announces the appointments of **Frederick Parker** and **Norman L. Frank** to the Standards, Estimating, and Industrial Engineering Dept.

General Electric Co.'s Superpower Microwave Tube Laboratory, Power Tube Dept. announces the appointments of **Dr. Garland M. Branch** — Consulting Microwave Physicist; **Roger J. Segalla** — Radio Frequency Measurements Specialist, **Charles W. Bleichner** — Circuitry Engineer; and **Jerome J. Hamilton** and **W. John Pohl** as Design Engineers.



In less time than it takes light to cross this room, a new product, **DELCO'S NEW** high speed **10 MC** silicon modules, could: (1) correct the course of a missile in flight; (2) make it possible for sonar pickups to track and compute the position of targets with microsecond accuracy; and (3) handle any number of other airborne guidance and control functions that previous modules—due to low speed or environmental or performance limitations—could not handle. Delco Radio's 10mc modules, with a maximum gate-switch speed of 40 nanoseconds, convert data 100 times faster—even under the most extreme environmental conditions.

These **SILICON** modules come epoxy encapsulated, and operate over a temperature range of −55°C to +100°C. And these same reliable **DIGITAL** circuits are available packaged on plug-in circuit cards. These Delco **MODULES** are environmentally proved to: **SHOCK,** 1,000G's in all planes. **VIBRATION,** 15G's at 10 to 2,000 cps. **HUMIDITY,** 95% at max. temp. **STORAGE AND STERILIZATION TEMP.** −65°C to +125°C. **ACCELERATION,** 20G's. Designed for systems using from one module to 100,000, and the module's rated performance considers the problems of interconnection. Data sheets are available. Just write or call our Military Sales Department.

Physicists and electronics engineers: Join Delco Radio's search for new and better products through Solid State Physics.

PIONEERING ELECTRONIC PRODUCTS THROUGH SOLID STATE PHYSICS

Division of General Motors • Kokomo, Indiana

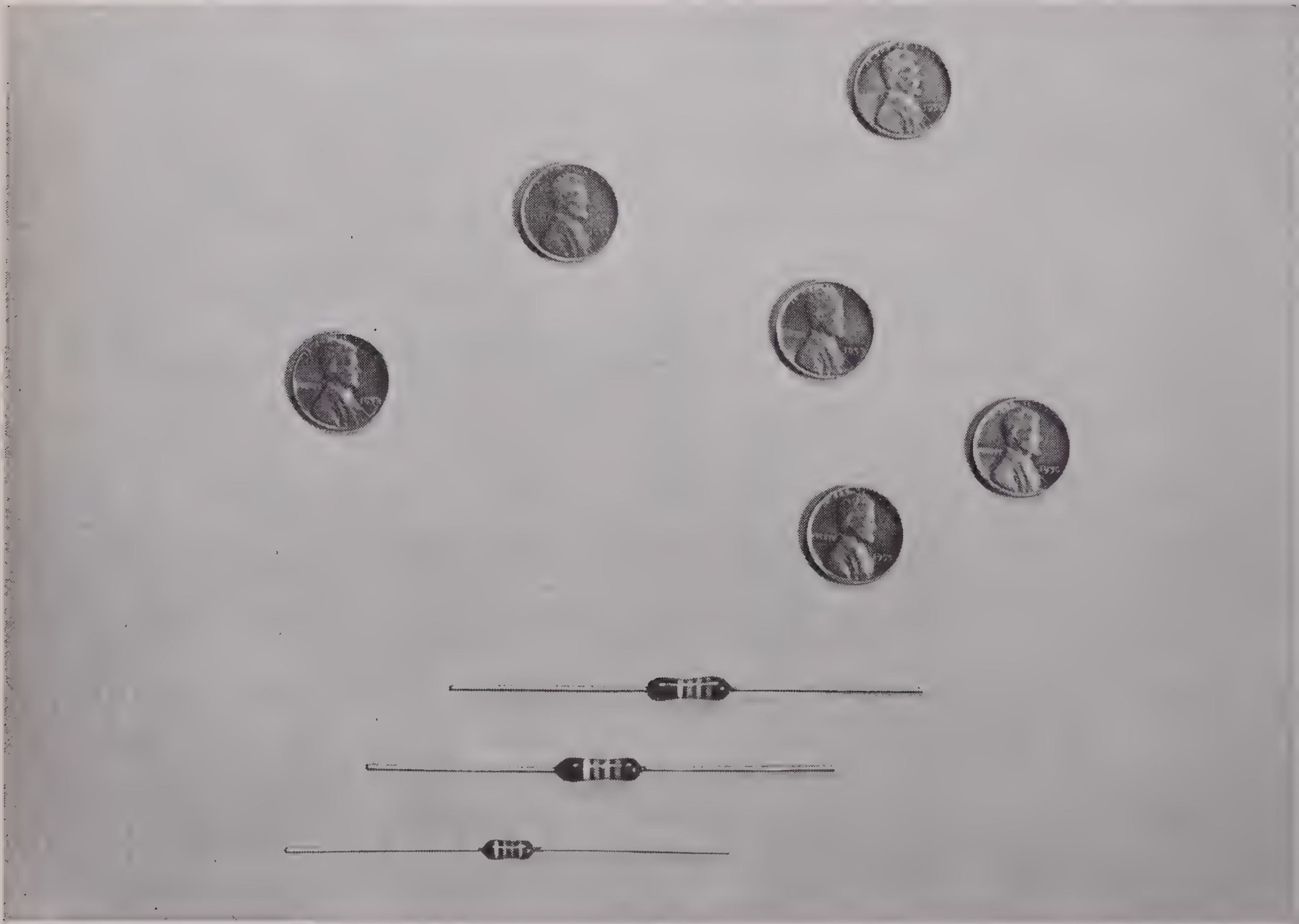
DELCO
RADIO

Circle 59 on Inquiry Card

GET 5% DESIGN TOLERANCE IN CORNING C RESISTORS FOR 6¢

You can design better circuits for less money when you *know* your resistance values won't budge more than 5% . . . ever. Corning C resistors give you this assurance of stability, the kind that lets you drop an entire amplifier stage or use broader tolerance, cheaper tubes or transistors. We build stability into ½, 1 and 2 watt C resistors with a tin-oxide conductor fired into a glass substrate. The helix is cut under precise electronic control. Then we add a special solvent-resistant insulation. These resistors meet MIL-R-22684 (Navy) all the way . . . and cost as little as 6¢. Use C resistors in place of composition types to boost product performance at virtually the same cost *or* to maintain the high performance of precision-type resistors at much less cost.

New, free booklet Get full details on C resistors and the remarkable design tolerances they give you. Write for "The Story Behind the Corning C Resistor" and for Data Sheet CE-2.12 to Corning Glass Works, 546 High Street, Bradford, Pa.



CORNING ELECTRONIC COMPONENTS
CORNING GLASS WORKS, BRADFORD, PA.

Circle 60 on Inquiry Card

KLYSTRON AND TWT ACCESSORIES

FOR LITTON AND OTHER TUBES

Klystron Focus Coils
TWT Solenoids
Water Loads
Radiation Shields
Cathode Sockets & Fingers

Litton microwave tube accessories have largely been confined in the past to those required by Litton tube users. Now, Litton develops and produces a variety of tube accessories to customer specifications, *regardless of tube manufacturer* or application.

Focus Coils and Solenoids: Foil or wire wound in any size — from low-noise TWT's to super-power klystrons. Epoxy impregnated by vacuum or pressure. One terminal board. One coolant input/output manifold. Leak-resistant cooling systems. Integral lead shielding.

Water Loads: For L through C bands. Seamless aluminum guide construction. Light, short, versatile. Excellent pressure integrity to 50 psia. Super or medium power. Low VSWR with high peak and average power ratings. Typical L-band unit tested to 20 megawatts peak power, 50 KW average power.

Other Litton tube accessories are radiation shields, differential thermopiles, and cathode sockets and contact fingers.

For more data, write to: Litton Industries, Electron Tube Division, San Carlos, California. Or telephone LYtell 1-8411.

LITTON INDUSTRIES
Electron Tube Division
MICROWAVE TUBES AND DISPLAY DEVICES

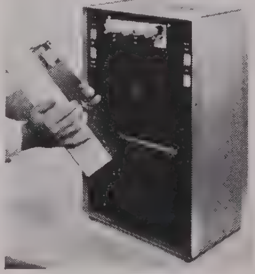
Circle 57 on Inquiry Card

P. I. tape recorder secret is an open book

A unique stacked-reel tape magazine is one of many space-saving secrets which enable Precision instrumentation recorders to out-perform conventional magnetic tape instruments many times their size. Other design secrets are push-button selection of function and speed, light beam end-of-tape sensing, front panel calibration and testing, interchangeable tape loop magazines, and all-solid-state plug-in electronics.

All the secrets of these recorders are unveiled in detailed new brochure 55B. Write for your copy today.

P.S. — Here's an installation secret — two complete 14-channel analog (or 16-channel digital) recorders mount in only 51" of vertical rack space.



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Loaded magazines can be interchanged in 5 seconds.

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REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Books

The Physical Theory of Transistors

By Leopoldo B. Valdes. Published 1961 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. 370 pages. Price $10.50.

Flow of current through semiconductor materials is analyzed and relationships derived between the electrical characteristics of transistors and their physical structure. Many aspects of solid-state physics are discussed in order to clarify this study. The book is intended for a graduate course in transistor physics, and as a reference for those already working in this expanding field. Some introductory material is included to unify the various concepts making up the study of transistors.

Static Relays for Electronic Circuits

Edited by Richard F. Blake. Published 1961 by Engineering Publishers, Elizabeth, N. J. Trade Distributors: Reinhold Publishing Corp., New York and Chapman & Hall, Ltd., London. 198 pages. Price $7.00.

Basic design, properties and characteristics, and application factors of Static Relays—a new electronic component based on semiconductor principles—are discussed in this book. Case histories showing how Static Relays have been used in commercial equipment are also given. Written by a staff of specialists, this book gives facts and figures about Static Relays and how to use them.

Value Engineering, Vol. 2

Edited by R. S. Mandelkorn. Published 1961 by Engineering Publishers, Elizabeth, N. J. Trade Distributors: Reinhold Publishing Corp., N. Y. and Chapman & Hall, Ltd., London. 167 pages. Price $7.50.

How you as a businessman, can meet increasingly fierce competition from both domestic and foreign sources is answered in this book. The 24 chapters explain how the principles of modern Value Engineering are used to reduce the cost of manufactured products while maintaining, and even improving, the quality.

Field Computations in Engineering and Physics

By A. Thom and C. J. Apelt. Published 1961 by D. VanNostrand Co., Inc., 120 Alexander St., Princeton, N. J. 165 pages. Price $5.75.

This book describes the numerical solution of partial differential equations in two dimensions by Professor Thom's Squaring Method. The book deals with the linear equations of Laplace and Poisson, and with the nonlinear equations governing the flow of a compressible fluid and the flow of a viscous fluid both in two dimensions and in three dimensions with axial symmetry. Attention is concentrated on speed and ease of manipulation. Difficulties which so often arise in such numerical solutions are dealt with and questions on the convergence of the process and its accuracy are considered in detail.

(*Continued on page* 83)

124 completely hermetically sealed Microwave Mixer and Video Diodes

ALL ARE DIRECTLY SUBSTITUTABLE FOR CONVENTIONAL DIODES TO ASSURE UNPRECEDENTED SYSTEMS RELIABILITY.

Microwave Associates has answered your need for truly hermetically-sealed diodes. For the first time, both fixed-base and reversible polarity types have CERAMIC-TO-METAL SOLDER SEALS plus SOLDER END SEALS.

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The MA-458F, for example, replacing the 1N23E, has a calculated overall noise figure of 7.0 db — the lowest noise figure available for high reliability applications.

These diodes (and coaxial case and subminiature glass packaged diodes) assure military and commercial applications the reliability essential to uninterrupted service for exceptional time spans. They perform to 150°C and meet the applicable environmental requirements of MIL-S-19500.

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SILICON MIXER DIODES

1 Mc — 4,000 Mc

CARTRIDGE CASE

Improved Types
For low noise superheterodyne mixer performance
• Replace 1N21 series

Fixed Base Types		Matched Pair		Reversible Polarity Types	Calc. Overall Rec'r Noise Figure N_{IF} = 1.5db (db)	Burnout Rating (ergs)
Forward Polarity	Reversed Polarity	Forward Pair	Forward & Reversed			
MA-449B	MA-449BR	MA-449BM	MA-449BMR	MA-459B	10.3	5.0
MA-449C	MA-449CR	MA-449CM	MA-449CMR	MA-459C	8.2	[illegible]
MA-449D	MA-449DR	MA-449DM	MA-449DMR	MA-459D	7.8	[illegible]
MA-449E	MA-449ER	MA-449EM	MA-449EMR	1N21WE	7.0	5.0
MA-449F	MA-449FR	MA-449FM	MA-449FMR	MA-459F	6.0	[illegible]

Higher Burnout Types
For use in pulse radars or other receivers exposed to high RF radiation fields.
• Interchangeable with 1N21 series

MA-4127	MA-4127R	MA-4127M	MA-4127MR	MA-4132	8.3	10

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4126	MA-4126R	MA-4126M	MA-4126MR	MA-4131	—	2.0
MA-4126A	MA-4126AR	MA-4126AM	MA-4126AMR	MA-4131A	—	2.0

4,000 Mc — 10,000 Mc

Improved Types
For low noise superheterodyne mixer performance.
• Replace 1N23 series

MA-451B	MA-451BR	MA-451BM	MA-451BMR	MA-458B	11.4	2.0
MA-451C	MA-451CR	MA-451CM	MA-451CMR	MA-458C	9.8	2.0
MA-451D	MA-451DR	MA-451DM	MA-451DMR	MA-458D	8.2	2.0
MA-451E	MA-451ER	MA-451EM	MA-451EMR	IN23WE	7.5	2.0
MA-451F	MA-451FR	MA-451FM	MA-451FMR	MA-458F	7.0	2.0

Higher Burnout Types
For use in pulse radars or other receivers exposed to high RF radiation fields.
• Interchangeable with 1N23 series

MA-4133	MA-4133R	MA-4133M	MA-4133MR	MA-4134	9.8	5.0

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4125	MA-4125R	MA-4125M	MA-4125MR	MA-4130	—	2.0
MA-4125A	MA-4125AR	MA-4125AM	MA-4125AMR	MA-4130A	—	2.0

10,000 Mc — 18,000 Mc

COAXIAL CASE

Improved Types
For low noise superheterodyne mixer performance.
• Replace 1N78 series

MA-433	MA-443R	MA-443M	MA-443MR	—	—	0.6
MA-443A	MA-443AR	MA-443AM	MA-443AMR	—	9.8	0.6
MA-443B	MA-443BR	MA-443BM	MA-443BMR	—	8.8	0.6
MA-445	MA-445R	MA-445M	MA-445MR	—	—	1.0
MA-445A	MA-445AR	MA-445AM	MA-445AMR	—	9.8	1.0
MA-445B	MA-445BR	MA-445BM	MA-445BMR	—	8.8	1.0

Lower Noise Types
For best signal-to-noise performance in low frequency IF doppler systems.

MA-4124	MA-4124R	MA-4124M	MA-4124MR	—	—	0.6
MA-4124A	MA-4124AR	MA-4124AM	MA-4124AMR	—	—	0.6

SILICON VIDEO DIODES

1 Mc — 10,000 Mc

Improved Types For high tangential signal-to-noise sensitivity in simplified beacon receivers, test equipment and other uses.
• Replace MA-408 series **CARTRIDGE CASE**

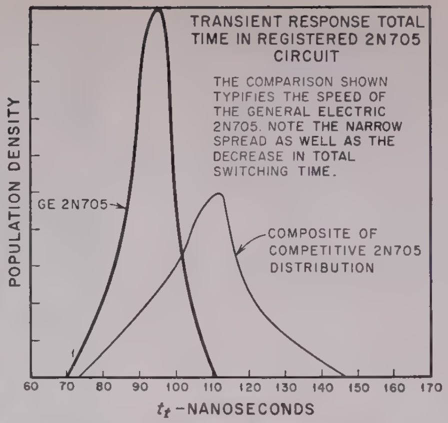
Fixed Base Types		Reversible Polarity	Burnout (ergs)
Forward Polarity	Reversed Polarity		
MA-452	MA-452R	MA-461	1.0
MA-452A	MA-452AR	MA-461A	1.0
MA-452B	MA-452BR	MA-461B	1.0

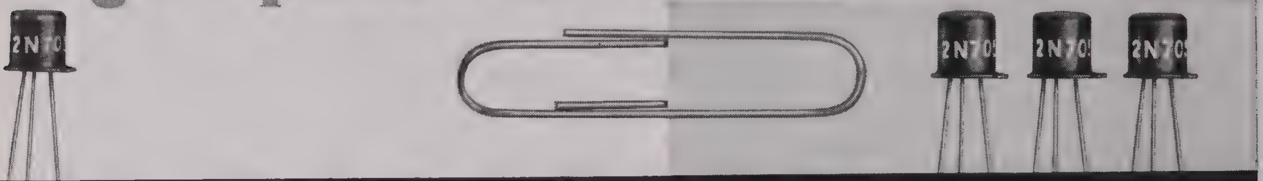
Higher Burnout Wide Dynamic Range Types
For use in video receivers exposed to high RF radiation fields.
• Interchangeable with MA-408 series

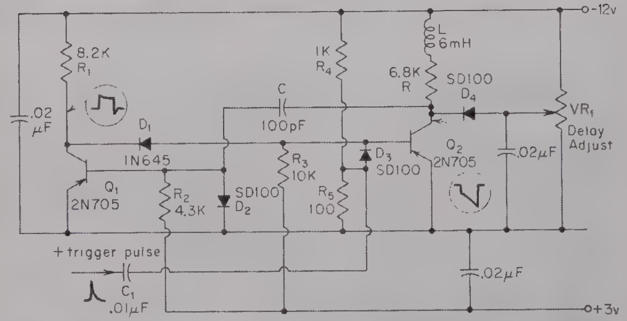
MA-4128	MA-4128R	MA-4129	5.0

Circle 63 on Inquiry Card

600 MCS GAIN-BANDWIDTH PRODUCT... with General Electric's High Speed Germanium Mesa







INDUCTOR-RESISTOR COMBINATION AS "CONSTANT-CURRENT" CHARGING SOURCE

Using fast transistors such as the G-E 2N705 germanium mesa, with careful design accurate delay generators may be fashioned. The circuit shown typically maintains an accuracy of 1% over the temperature range from −20°C through + 80°C. It also has the additional virtue of being *continuously adjustable* by simple screw-driver manipulation over the range of *30 nanoseconds through 1 microsecond.*

If high speed is your problem in industrial and military switching applications, G-E type 2N705 germanium PNP triode mesa transistor offers you the performance and reliability you have been looking for. Extended life tests to 7,000 hours document the reliability story. And gain-bandwidth product of 600 mcs answers the question of speed. It is also designed to meet the mechanical and environmental requirements of MIL-S-19500/B.

For low cost computer applications, specify General Electric 2N711. For other lower voltage, lower cost applications, types 2N710, 2N725, and 2N1646 are also available. Your Semiconductor Products District Sales Manager can give you all the technical details. Or write to Semiconductor Products Department, Section 241105, General Electric Company, Electronics Park, Syracuse, New York.

PUT **PEP** IN YOUR DESIGNS

RATINGS AND CHARACTERISTICS (25°C)

	2N705		2N711		
Dissipation					
Total Dissipation (25°C Ambient)*	150		150		mw
	Min.	Max.	Min.	Max.	
Static Characteristics					
Collector Cutoff Current ($V_{CB} = -5V$)		−3		−3	µa
Voltage Characteristics					
Collector to Emitter Breakdown ($I_C = -100$ µa)	−15		−12		volts
Collector to Emitter Saturation 2N705 ($I_B = -0.4$ ma., $I_C = -10$ ma)		−0.3		−0.5	volts
2N711 ($I_B = -0.5$ ma., $I_C = -10$ ma)				−0.5	volts
High Frequency Characteristics					
Gain-Bandwidth Product ($I_E = 10$ ma, $V_{CE} = -5V$)	600**		600**		mcs.

*Derate 2 mw/°C increase in case temperature above 25°C.
**Typical

FOR FAST DELIVERY OF HIGH SPEED GERMANIUM MESA TRANSISTORS AT FACTORY-LOW PRICES, CALL YOUR G-E SEMICONDUCTOR DISTRIBUTOR

GENERAL ELECTRIC

Circle 64 on Inquiry Card

Books

(*Continued from page* 80)

Cybernetics, 2nd Edition

By Norbert Wiener. Published 1961 by The Technology Press, M.I.T. and John Wiley & Sons, Inc., 440 Park Avenue, South, New York 16, N. Y. 212 pages. Price $6.50.

The book, in a very strict sense, describes the application of statistical mechanics methods to communications engineering, with subject matter ranging from such control mechanisms as mathematical calculators to the nerves and brain of the human body. This revised second edition has been completely re-edited and contains two new chapters and a new introduction.

Elements of Nuclear Engineering

By Glenn Murphy. Published 1961 by John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 213 pages. Price $7.50.

The text material is arranged in three principal sections. The first section contains concepts, principles, and ideas necessary for an engineering understanding of nuclear transformations and radiation. The second section contains a simplified presentation of modified one-group theory of homogenous, bare, thermal reactor cores. The third section contains a survey of radiation, its measurement, some of its engineering applications, and consideration of the hazards carried with it.

Microwave Antennas

By A. Z. Fradin. Published 1961 by Pergamon Press, 122 East 55th Street, New York 22, N. Y. 668 pages. Price $15.00.

Classification of microwave antennas is introduced with descriptions of their structure and operating characteristics. Fundamental principles of microwave antenna theory and both rigorous and approximate methods for their analysis are described. An entire chapter is devoted to a solution of a number of mathematical problems of diffraction at openings in plane screens by approximate methods, to which the determination of the radiation characteristics for the majority of microwave antennas is reduced. Individual types of antennas are examined in detail. For each of the types the various forms are analyzed, the question of structure is discussed and the contemporary state of the theory is explained.

Progress in Semiconductors, Vol. 5

Edited by A. F. Gibson. Published 1961 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 316 pages. Price $11.00.

This book is one of an annual series. The articles generally will be critical reviews, giving an assessment of the present state of knowledge. Some, however, will contain significant amounts of original work. Each volume will be fully international.

(*Continued on page* 84)

WILLIAM D. KELLY, CHIEF ENGINEER, WNEW-TV, NEW YORK, SAYS:

"OUR NEW CONRAC PICTURE/PULSE CROSS MONITORS IMPROVED OUR OPERATING EFFICIENCY."

"It's a big help in examining our video signal to assure perfect synchronization and to quickly determine the quality of the sync pulses," Mr. Kelly adds. "This is by far the most versatile and useful monitor we have ever used."

The new Conrac fully regulated monitor will display either sync or normal picture at the flick of a switch. The 3-position, front-panel switch permits selection between normal picture, pulse cross, and pulse cross expanded. In the last position, vertical expansion of approximately five times shows each horizontal line clearly. In both pulse cross positions, video is inverted (black is white) and auxiliary brightness is provided. Thus, pulse cross brightness can be preset at a different level from that employed when viewing the normal picture.

Mr. Kelly's appraisal of this monitor and his experience with other Conrac monitors is not unusual. Consistency in quality, dependability, and versatility are Conrac characteristics known and preferred wherever a need for monitors exists in the broadcasting industry.

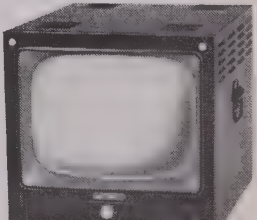
FROM 8" THROUGH 27", BROADCAST AND UTILITY, EVERY CONRAC MONITOR HAS A COMBINATION OF UNIQUE FEATURES.

★ *Video response flat to 10 megacycles*

★ *DC restorer with "in-out" switch*

★ *Selector switch for operation from external sync*

★ *Video line terminating resistor and switch*



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A DIVISION OF GIANNINI CONTROLS CORPORATION

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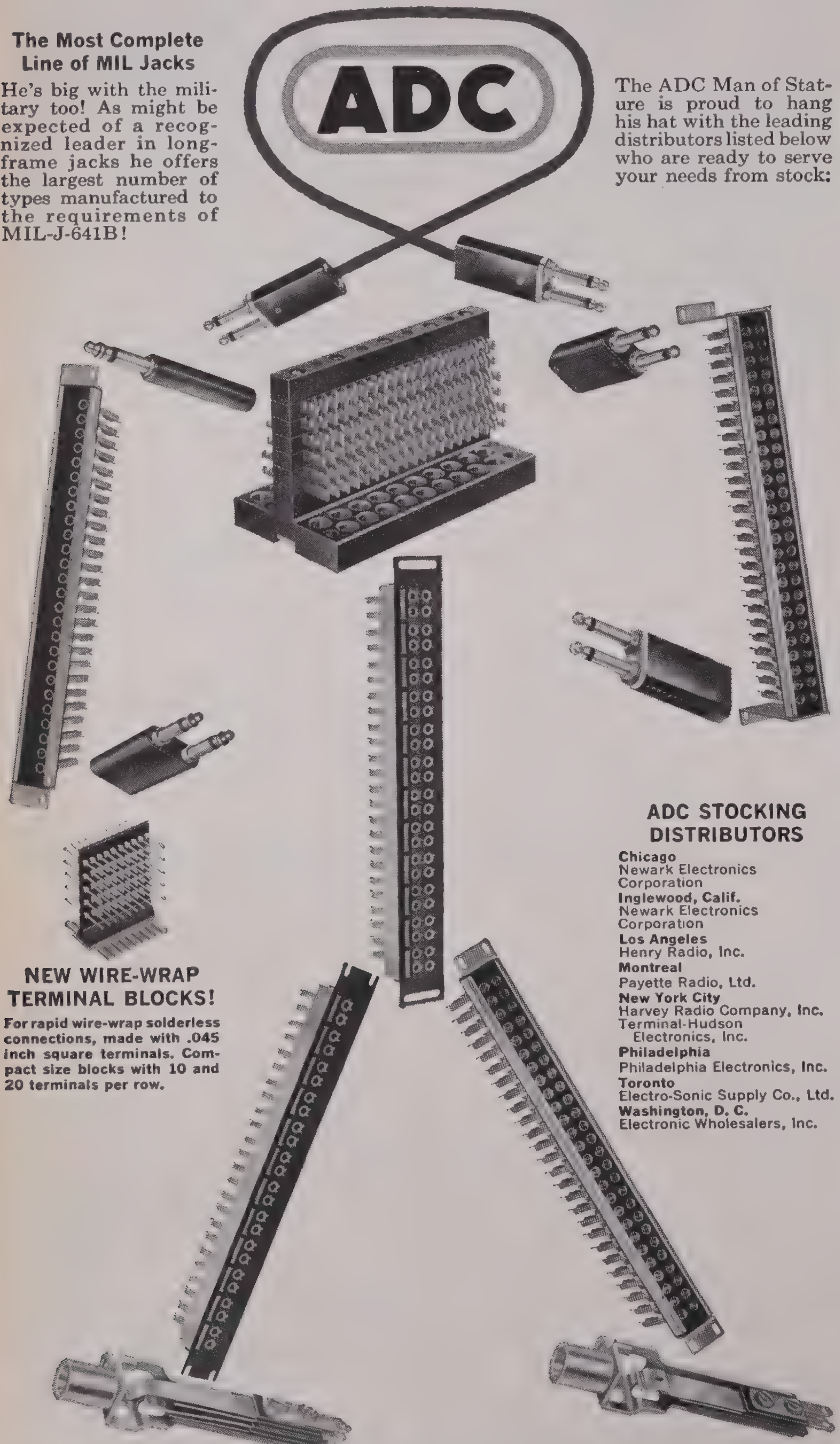
MAN of STATURE

In Communication Components

Since he's composed 100% of ADC plugs, jacks, jack panels, patch cords and terminal blocks naturally he's the ultimate in reliability. He cuts quite a broad swath in his chosen field too. Anywhere audio signals are switched or distributed you'll find more components of this type with his brand than any other. He offers the widest choice of types and models and speedy delivery from stock.



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He's big with the military too! As might be expected of a recognized leader in long-frame jacks he offers the largest number of types manufactured to the requirements of MIL-J-641B!

The ADC Man of Stature is proud to hang his hat with the leading distributors listed below who are ready to serve your needs from stock:

NEW WIRE-WRAP TERMINAL BLOCKS!

For rapid wire-wrap solderless connections, made with .045 inch square terminals. Compact size blocks with 10 and 20 terminals per row.

ADC STOCKING DISTRIBUTORS

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TRANSFORMERS • REACTORS • FILTERS • PLUGS and JACKS • JACK PANELS

Books

(*Continued from page* 83)

Transmission of Information

By Robert M. Fano. Published 1961 by The Technology Press, Mass. Inst. of Technology and John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 389 pages. Price $7.50.

This book presents the foundations and major results of information theory. It has evolved out of a graduate course taught by the author and includes some previously unpublished research. It provides an up-to-date treatment of coding theory that emphasizes those formulations and mathematical techniques that have proved to be of greatest engineering significance.

Books Received

Tube Location Guide, Vol. 11

Published 1961 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 96 pages. Paperbound. Price $1.25.

Fundamentals of UHF

By Allan Lytel. Published 1961 by John F. Rider Publisher, Inc., 116 West 14th Street, New York, N.Y. 153 pages. Paperbound. Price $3.90.

Basic Mathematics, Vol. 2

By Norman H. Crowhurst. Published 1961 by John F. Rider Publisher, Inc., 116 West 14th Street, New York, N. Y. 144 pages. Paperbound. Price $3.90.

Electrical and Electronic Test Equipment Data Handbooks, Revised Edition

Published 1961 by Frederick Research Corp., 2601 University Boulevard, West Wheaton, Md. Over 4,000 pages in eleven books. Price $200.00.

Technical Publications Opinions, Vol. 1, No. 1

By Thomas R. O'Neill. Published 1961. 26 pages. Price $2.00. Copies may be purchased by writing to Thomas R. O'Neill, P.O. Box 441, Passaic, N.J.

1959 Digest of Literature on Dielectrics

L. J. Frisco & T. D. Callinan, Eds. Published 1960 by the National Research Council, Washington 25, D.C. 421 pages. Price $8.00.

Television and Radio Repairing, 2nd Edition

By John Markus. Published 1961 by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y. 576 pages. Price $8.95.

Introduction to Hi-Fi

By Clement Brown. Published 1961 by Gernsback Library, Inc., 154 West 14th St., New York 11, N.Y. 188 pages. Paperbound. Price $3.20.

Microwave Ferrites

By P. J. B. Clarricoats. Published 1961 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 260 pages. Price $8.00.

Oscillator Circuits

By T. M. Adams. Published 1961 by Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 6, Ind. 128 pages. Paperbound. Price $2.95.

Circle 66 on Inquiry Card

DESIGN WITH ARNOLD 6T CORES...

SAME-DAY SHIPMENT OF STANDARD DELTAMAX CORE SIZES

Arnold 6T tape cores (aluminum-cased and hermetically-sealed) offer you three very important design advantages. *One:* Maximum compactness, comparable to or exceeding that previously offered only by plastic-cased cores. *Two:* Maximum built-in protection against environmental hazards. *Three:* Require no supplementary insulation prior to winding and can be vacuum impregnated after winding.

Now we've added a fourth vital advantage: Maximum availability. An initial stock of approximately 20,000 Deltamax 1, 2 and 4-mil tape cores in the proposed EIA standard sizes (See AIEE Publication No. 430) is ready on warehouse shelves for your convenience. From this revolving stock, you can get immediate shipment (*the same day order is received*) on cores in quantities from prototype lots to regular production requirements.

Use Arnold 6T cores in your designs for improved performance and reduced cost. They're guaranteed against 1000-volt breakdown . . . guaranteed to meet military test specifications for resistance to vibration and shock . . . guaranteed also to meet military specifications for operating temperatures. The 6T hermetic casing method is extra rigid to protect against strains.

Let us supply *your* requirements. Full data (Bulletin TC-101A and Supplements) on request. • Write *The Arnold Engineering Company, Main Office and Plant, Marengo, Ill.*

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VARIATION OF DELTAMAX HYSTERESIS LOOP
WITH PEAK MAGNETIZING FORCE
READY
TO ROLL!
RIGHT
FROM
STOCK

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PROVEN RELIABILITY

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VISUAL MICROWAV

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stride in advancing
state of the art for mi
wave research and deve
ment—you can now obs
a complete *4,000 mc* b
width on *one scope, at*
time, with the new M
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Analyzer.

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engineers. To see the *en*
tuning range of trans
ters, generators and
other broadband dev
just push one approp
band selection button
tracking, no further tu

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wide band of frequenci
one time, you can see i
fering signals insta
And by switching ove
narrow band analysis,
exact nature of the si
can be determined—an
in compiling a "spect
signature."

Model WSA joins the
comprehensive line of v
microwave analysis eq
ment available today.

SPECIFICATIONS MODEL

Frequency Range
10 mc to 40,000 mc in 20

Band Selection
Automatic; with illumi
pushbuttons

Dispersion
Narrow Band: 1 mc to 25
Wide Band: 50 mc to 4,00

Resolution..........Narrow Band:
Wide Band: 1

I-F Frequencies
8,200 mc, 3,600 mc, 1,000 m
mc, depending on band selec

High Intermediate Frequency
Assures image rejectio
prevents video detecti

DISPLAY FOR ANALYSIS

Which of these Polarad Microwave Spectrum Analyzers solves your problem?

From 10 to 100,000 mc, Polarad offers spectrum analyzers for every aspect of microwave research and development. Thousands of the instruments shown here are in use today throughout the electronics industry—in laboratories, on the production line, in systems, out in the field and at research centers.

Ask your Polarad representative to work with you in selecting the equipment that will most efficiently accomplish your objectives.

ALL POLARAD SPECTRUM ANALYZERS FEATURE:

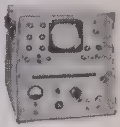
- 1 to 30 cps adjustable sweep rate
- Direct-reading UNIDIAL® tuning control, with no klystron modes to set
- High accuracy, resolution and sensitivity
- Non-contacting klystron cavity chokes for noiseless tuning
- Provision for use with Multi-pulse Spectrum Decoder (Model SD-1)

UNIVERSAL OPERATION?

Self-Contained Units Cover
10 to 40,880 mc
MODEL SA-84

- **Dispersion:** 10 to 55 mc: 500 kc to 5 mc, adjustable
  55 to 40,880 mc: 500 kc to 25 mc, adjustable
- **Resolution:** 20 kc
- **Internal Marker:** variable

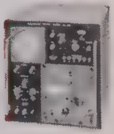
MODEL SA-84W



- **Wide Dispersion:** 10 mc to 240 mc: 10 mc
  240 mc to 40,880 mc: 80 mc
- **Resolution:** 2 kc to 80 kc variable
- **Crystal controlled markers from 10 to 40,880 mc**
- **Log-linear display**
- **Accurately calibrated IF attenuator**

TRANSISTORIZED MOBILITY?

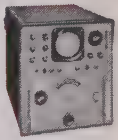
MODEL SA-84T
Single Unit Covers
10 to 40,880 mc



- **Dispersion:** 500 kc to 25 mc, adjustable
- **Resolution:** 20 kc at all frequencies
- **Internal Marker:** ± 13 mc
- **Power Consumption:** when battery operated, 110 watts, 12 vdc
- **Sensitivity:** —50 to —105 dbm, depending on frequency.
- **Weight:** 70 lbs. One half the weight of conventional vacuum-tube equivalent
  Meets MIL-1-26600 for r-f interference

STANDARD OPERATION?

MODEL TSA
10 to 44,000 mc in 5 Plug-In Tuning Units



- **Dispersion:** 400 kc to 25 mc
- **Resolution:** 2 to 80 kc variable
- **Attenuation:** Continually variable
- **Sensitivity:** —50 to —95 dbm, depending on frequency
- **Internal Marker:** ± 14 mc

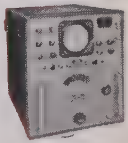
TIME AND FREQUENCY DISPLAY?

MODEL TSA-S
SYNCHROSCOPE ANALYZER
10 to 44,000 mc in 5 Plug-In Tuning Units

- **Bandwidth:** 5 kc, 50 kc, 500 kc, 5 mc
- **Synchroscope sweep rate:** 2, 10, 100, 1,000, 10,000, and 100,000 μ sec per screen diameter.
- **Dispersion, Sensitivity and Internal Marker** same as TSA.

WIDE DISPERSION?

MODEL TSA-W
Narrow And Wide Pulse Analysis
10 to 44,000 mc in 5 Plug-In Tuning Units



- **Dispersion:** 200 kc to 80 mc (2 ranges)
  80 mc dispersion displays pulses narrow as 0.1 μ sec. For wide pulses, dispersion may be adjusted down to 200 kc.
- **Resolution:** 2 to 80 kc variable
- **Internal Marker:** ± 40 mc
- **Screen Display:** Linear or log

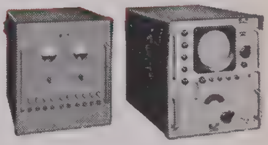
ULTRA-BROAD BAND?

MODEL WSA
Self-Contained Unit Covers
10 to 40,000 mc in 20 Bands

- **Dispersion:** 1 mc to 25 mc in narrow band, 50 mc to 4000 mc in wide band
- **Resolution:** 20 kc in narrow band; 1.5 mc in wide band
- Rapid band selection by means of illuminated push-button switches.
- Frequency difference marker up to 4000 mc.
- **Sensitivity:** —50 to —80 dbm, depending on frequency

EXTENDED FREQUENCY?

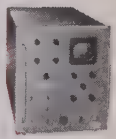
MODEL DA-70
50,000 mc to 100,000 mc
in Three Bands



- **Dispersion:** Continuously adjustable from 50 mc to 1000 mc. Permits narrow pulse inspection.
- **Resolution:** 1 mc
- High intermediate frequency assures image rejection and prevents video detection.
- **Dial Frequency Accuracy:** ±1.0%
- **Nominal Sensitivity:** —50 dbm for entire frequency range.

SPECTRUM SELECTOR?

MODEL SD-1
MULTI-PULSE SPECTRUM SELECTOR



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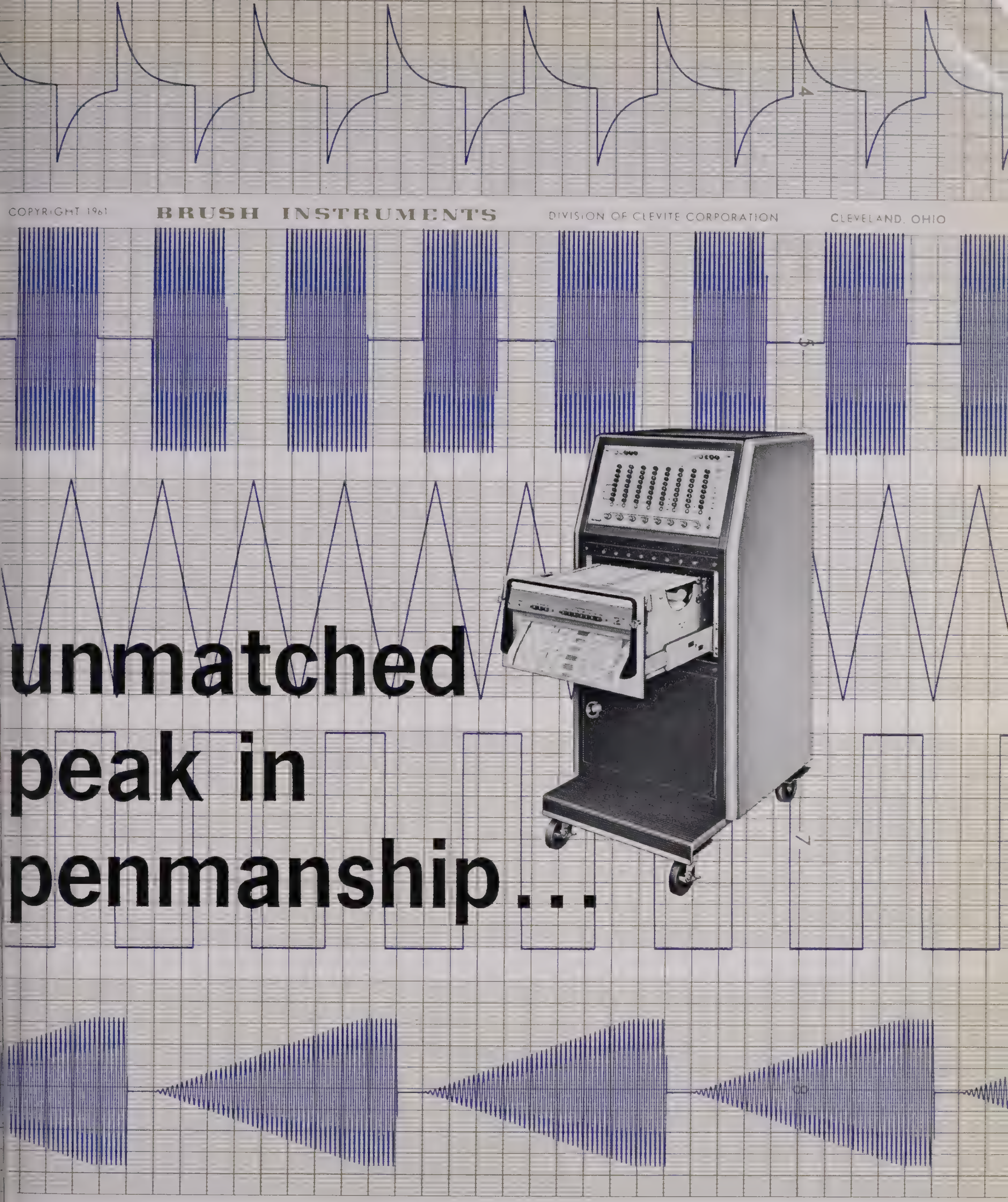
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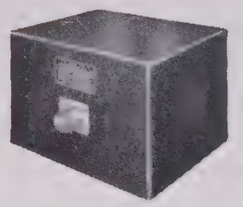

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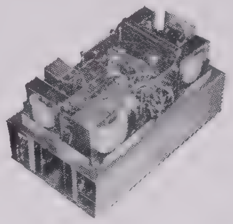

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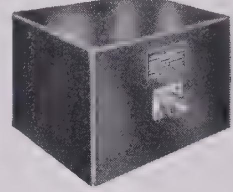

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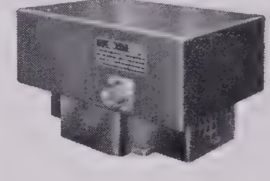

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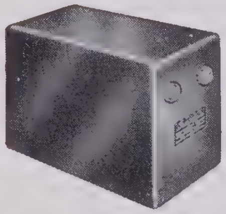

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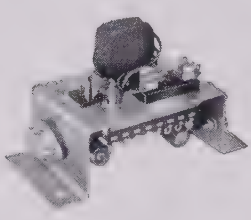

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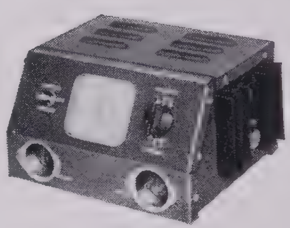

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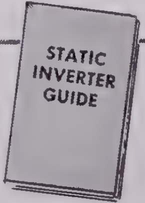

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ELECTRONICS

Next month

1961 SURVEY OF CATHODE-RAY OSCILLOSCOPES

This listing of cathode ray oscilloscopes and performance specificiations is the result of a survey just completed by ELECTRONIC INDUSTRIES of 'scope manufacturers here and abroad. Twenty nine manufacturers are represented in the chart which contains more than 150 types of oscilloscopes in production.

The survey covers real-time and storage CRT's. Every effort has been made to present in the space available the most significant data concerning each instrument.

S-PLANE AS AN AID TO FILTER DESIGN (PT. II)

Part I of this article created a good deal of interest in the engineering circles. In this second section, the author deals with the double-tuned band pass filter. The transformer coupled, double-tuned, band pass filter is analyzed by simple geometrical procedures in the S-plane. It is shown how a simple pencil compass is sufficient to construct the locus of the hump frequencies, and both the 3 and 6 db bandwidth frequencies.

HOW TO USE THE TUNNEL DIODE CURVE

Through quantum mechanics Esaki predicted the I-V characteristic curve for a tunnel diode. This article shows how to evaluate that integral and produce a useful algebraic equation for the curve.

PREVIEWING THE NATIONAL ELECTRONICS CONFERENCE

This year's NEC show in Chicago will feature over 400 electronic exhibits, including Military and Government agency special space science exhibits. Approximately 100 technical papers will be presented during the 3-day conference. In this special preview, EI will describe the exhibits and papers program, give details on field trips and social activities.

Plus all other regular departments

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, EI Totals, Snapshots of the Electronic Industries, EI International, News, Briefs, Tele-Tips, Books, Representatives News, International Electronic Sources, Personals, etc.

COMING SOON—

LATEST DIRECTORY OF MICROWAVE MANUFACTURERS

A comprehensive survey of manufacturers active in the microwave field, with the products that they manufacture.

MICROWAVE POWER DEVICE CHART

This fourth annual survey of microwave power devices will cover technical specifications on magnetrons, klystrons, planar triodes, and tetrodes, traveling wave tubes and backward wave tubes, as well as microwave semiconductors, varactors, etc.

Watch for these coming issues:

***NOVEMBER**
9th Annual Microwave Issue

***JANUARY**
Statistical and Annual Industry Review

***MARCH**
Annual IRE Issue

*From the knowledge gained through solid state electronics,
and the study of transistors and epitaxial growths,
the art of thin-film technique developed.
The building of crystalline structures by vaporizing and other methods
introduced new processes to grow metallic structures for electronic applications.
The technology has made extraordinary progress in the creation
of electronic components, and is leading to many revolutionary concepts.*

A Survey of Thin-Film

Part One of Two Parts

THIN film deposits provide a direct means to use the physical properties of metals. The structure of atoms and electron behavior within the various molecular and crystalline formations are controlled to give a specific electronic action.

In this art, the physical properties of metals and semi-metals can be studied by creating films less than a millionth of an inch thick, or the thickness of an atom. Other materials can be deposited in composite layers to build multistructure compositions for investigation purposes. These techniques enable the activities of electrons to be more closely examined, understood, and used.

The advantages of thin film components may be regarded as the same as solid state components, but promising far greater sophistication of use and construction. In addition, thin film components offer size reductions to the limits that are practical fo micro-miniaturization production.

Photo taken at the General Electric Research Laboratory by Dr. Benjamin W. Roberts shows patterns of magnetic domains in a thin film of magnetic material. Dark and light areas are magnetized in opposite directions.

The applications of thin film technology are i process of continuous development, however the art is broadly divided into (1) magnetic devices, (2) low temperature (cryogenic) superconductors, (3) passive components, such as resistors and capacitors and (4) photovoltaic devices. These subjects are discussed in detail in this article. Applications hav also been reported in phosphor thin film technique for cathode ray tubes, which will provide twent times more gain in brightness over the present powder-settled type screen. The full scope of thin fil technology has not yet made its impact on the electronics industry, however, it is hoped that this article will serve to acquaint engineers with the enormous potentials of this art.

To present the concepts of this technique th latest disclosure by RCA in the development of thin film transistor shows vividly the theory an practice in a simplified description.

Transistors have now been produced entirely b the vaporized thin-film technique. The method tha has been used to produce operating units in th laboratory fits in with present methods of makin thin-film devices of other types. A complete three stage amplifier including thin-film transistors an their connections could be produced by this mean on a surface only twice as wide as a human hair.

The new thin-film transistors and the fabrication technique used in the laboratory were developed by Dr. Weimer of RCA. The active materia used in this transistor is cadmium sulfide, a compound with considerably greater insulating properties than the germanium, silicon, and other semiconductor materials used in standard transistors.

In making the thin-film transistors, an evaporation process is used to deposit successive thin layer of cadmium sulfide and metal on a glass plate, creat-

Thin films of metals and insulators are deposited on a substrate in this device at the General Electric Research Laboratory. The material to be deposited is placed in metal boats which can be seen below the glass chimneys in this photo.

BY JOHN WATKINS
Assistant Editor
Electronic Industries

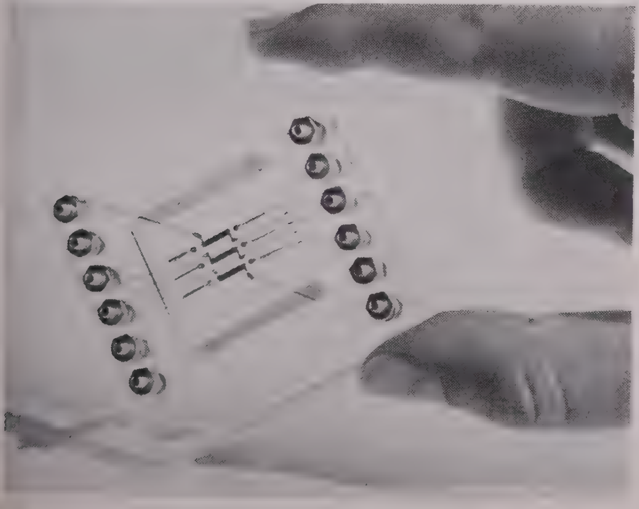
Technology

ing a device that is only a few ten-thousandths of an inch thick. In the evaporation process, the cadmium sulfide crystals and the metal are heated in successive steps in a vacuum. The vapor is collected by condensation on the glass plate in the same manner as steam condenses in a film on a cooler surface.

By using a special mask to cover portions of the plate during the process, the metal layers are deposited in a pattern that also forms the electrical contacts needed to operate the transistor. The masking process can also be used to produce various patterns of connections among many transistors, to complete a desired circuit at the same time as the transistors themselves are being made.

In conventional transistors having comparable functions, electrons flow more or less freely through the semiconductor material between two of the contacts, and the third element provides control by reducing the flow in varying degrees. The operating principle of the experimental thin-film transistors is exactly opposite to previous type transistors. The insulating properties of the cadmium sulfide hamper the flow of electrons between two electrodes, and the third element provides control by increasing the flow in varying degrees.

This innovation, with further devlopment, will permit extreme simplicity in the arrangement of circuits to link these devices in large arrays, especially useful for computer applications.



Shown here is an enlarged laboratory test unit containing three thin-film transistors made in special elongated form on a glass base. Formed from thin films of cadmium sulfide and metal deposited in successive stages, each of the devices is only a few ten-thousandths of an inch thick. An RCA development.

Thin-Film Electronics

Thin-film devices represent one of the major advances in the art of miniaturization.

Thin-film is obtained by vacuum-depositing metals, or other elements, on glass or ceramic substrates. The thickness of these deposits is on the order of 6 millionths of an inch and can be deposited to any form, or shape desired, in an array of patterns.

The term "Thin-Film" covers a wide range of different developments, and many varieties of materials. Most familiar is the magnetic vapor deposition used mainly for computer matrix memories. The new applications include resistors and capacitors.

From the quantum-mechanical analysis of tunnel diodes, electronic science has advanced into the practical use of these thin-film concepts, and a new generation of electronic components is now being developed.

NOTE: During the preparation of this article several developments in research of these thin-film techniques occurred. The disclosure by RCA of a thin-film transistor came as we went to press. As we try to conclude this series another company has promised us a further major disclosure for our October issue.

Thin Film *(Continued)*

Evolution of Microsystem Electronics

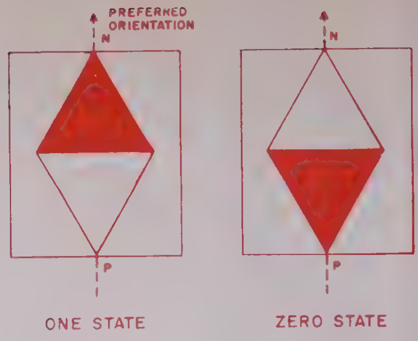
Thin-film integrated circuitry represents a major advance because it dispenses with separate mechanical supports for each component and combines multiple thin-film components on a single glass or ceramic substrate. Overlapping or touching films form internal connections. At present a hybrid form of thin-film integrated circuitry is necessary since none of the many companies working in this field were able to fabricate workable thin-film diodes and transistors on a glass or ceramic substrate. Current thin-film integrated circuit technology involves deposition of thin-film passive elements followed by the application of any required active semiconductor elements.

Semiconductor integrated circuitry means the combination of thin-film and semiconductor circuit elements on and within a single crystal semiconductor substrate. Connections are made by deposited thin-film conductors, and by physical juxtaposition. Of all the existing forms of integrated circuitry, the semiconductor version permits the widest variety of active and passive elements and the greatest potential flexibility. Active elements can be formed within or on the substrate where needed, and either thin-film or semiconductor techniques can be used to form the passive circuit elements. When semiconductor technologists have perfected a means of depositing thin-film semiconductor active elements on glass or ceramic substrates, the passive substrate approach may well prove more flexible than the active substrate approach. This comes about because part of each active element is unalterably connected to a common semiconductor crystal in the active case. Although careful placement of active elements and tailoring of the shape and thickness of the active substrate between may allow quite complicated circuits to be built into circuits, this could undoubtedly be achieved if both active and passive elements could be deposited on an insulating substrate.

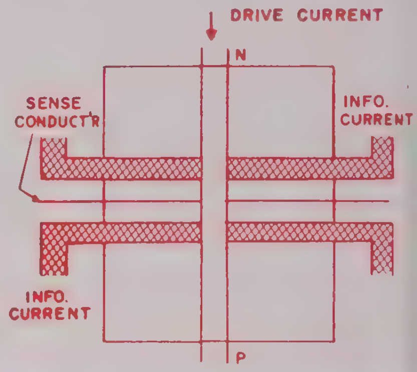
Processes

Of the various methods used to deposit Thin-Films the selection of each process is a matter of application, at least, no one method has a significant over-all advantage over the others. The researcher who uses one method naturally defends his choice, as future developments may justify his decision.

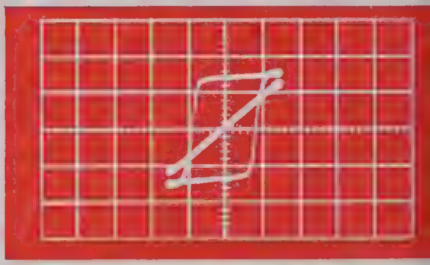
Vacuum deposition, sputtering, and electro-depositing are the major processes used in Thin-Film techniques. Electroplating is used, but it is limited because base metal cannot be deposited directly onto a substrate. Either sputtering, or vacuum vaporizing is required to lay down the initial deposition of metal. However, the subsequent processes carried out using the electro-depositing methods are considered to offer eventual advantages in simplifying mass production techniques. Electro-depositing has only been used in the Thin-Film production techniques for a short time, compared to vacuum deposition techniques. It is too early to assess the eventual outcome of either development.



Each bit is represented by a magnetic dipole having two stable states, "I" and "O," parallel to the preferred direction.



Wiring of a bit. (Courtesy Burroughs Corp.)



All area magnetic domains lie parallel to the direction of this field, and a film's magnetic characteristic in the preferred direction shows a square hysteresis loop.

Dark-horse of the situation is the sputtering technique, which has shown much promise as a direct, and stable method of deposition. However, it has not been widely used because it appears at first sight to be complicated and difficult to master.

Sputtering has proved to be mandatory for the deposition of metals that are too refractory to be evaporated except with elaborate equipment. A notable example of this is tantalum.

The chemical composition of metals which are sputtered remains constant, which is not the case using most evaporated alloys. These considerations may eventually decide the production method for general industrial processes. However, the development of new techniques is possible in either of the other methods, vacuum evaporated deposition, or electro-deposition.

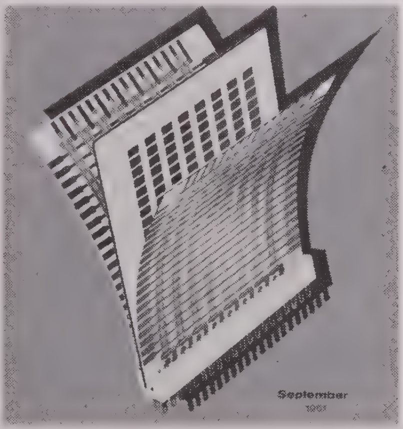
Magnetic Films

One of the problems of manufacturing magnetized Thin-Film is maintaining uniformity. In producing an experimental magnetized matrix of deposited films the individual magnetizations vary. Present techniques have solved most of these problems, but if the process could be made consistent the cost would be reduced to a fraction of the present price.

However, the cost is much less than the ferrite systems, and they offer advantages in that they accept greater drive tolerances, yield bipolar outputs, and can be driven by single polarity pulses for information entry and readout.

A deposit of nickel-iron alloy has a very rectangular hysteresis loop, resulting from a comparatively simple magnetic domain structure. Excellent photographs of these domain walls have been obtained and have shown much information on the physics of them. However, the fastest switching is obtained by rotating the magnetization, rather than by movements of the domain walls. It may be that the ideal film would show no domain pattern, except at the boundaries of the areas used for the current storage.

The properties of thin-films are not derived from the process of manufacture, but from the resulting thinness of the deposit. As the cross-section of the magnetic material producing the output signal is very small, the consequent rotational switching of re-magnetization is very fast. The thin-film output voltage is close to the peak voltage of a ferrite core; however, the voltage-time is less. In the applications of storage in computers, the use of magnetostrictive delay lines showed that two alloys can be used. Nickel-iron—with or without additions for control properties—has a delay almost independent of temperature. Cobalt-iron, on the other hand, gives a bigger signal. These properties are considered here to illustrate the relationship of voltage, time-delay, and amplitude as properties of metals.



A Burroughs magnetic thin film memory plane. (See cover.)

Thin Film Memories

A vapor film which is deposited on a substrate, while under the influence of a magnetic field, develops a magnetic domain in a preferred direction. A film magnetic characteristic in the preferred direction shows a square hysteresis loop. This direction is known as the "easy" direction. The "hard" direction is perpendicular to the easy field and shows a linear loop. These characteristics provide two constants, the wall coercive force in the easy direction, H_c, and the rotational saturating force in the hard direction, H_k.

It can be seen that the directional magnetic properties, and rotational re-magnetization are functions which must be considered in design applications. The use of the thin-film for the storage of a "bit" or binary code information for computer memories was one of the first practical applications.

The behavior of thin-film memories can be compared with a magnetic dipole having two states "N" and "P," which are both parallel to the easy direction. The two states represent the storage of a "one" or "zero," in the film element.

Memory Operation

The films are arranged as shown to provide a store of memory bits with their easy axis at a small angle to the drive conductor. The two stable states of the magnetic vector lie along the easy axis representing the stored binary bits. A word is stored by a row of films lying beneath the same drive conductor. Two other wires, the bit, and the sense conductors, run perpendicularly to the drive conductor passing over the columns of films in the matrix. Although the film is magnetized in manufacture in the easy directed, the magnetization is also found to be stable in the opposite direction. Therefore, there are two stable magnetized states available in the film.

The diagram shown represents the digits of a word, and are in this example magnetized to store the binary word. If a current field is applied to each of the films sufficient to swing the magnetic vector around to alignment with the applied field. This swing, or rotation induces a voltage in the sense wire the phase of which is caused by the original direction of magnetization. Thus, the stored digits are read out to the sense wires in the form of positive or negative signals. If the drive field were removed from the films, the magnetic vector would fall back to the nearest easy direction, or the 'zero' or 'one' indetermined position. To store a new word, the films which will have to hold 'ones' need their magnetic vectors titled to a position to allow the vector to fall to a 'one' when the drive current is removed.

To magnetize a selected area of thin film to the 'one' or 'zero' state, two magnetic fields are applied perpendicularly to each other, in the hard and easy directions. The information field is in the easy direction, and drive field in the hard direction. The resultant field lies between these fields and swing towards either negative or positive, depending on the direction of the information field. When the drive

Working in a typical laboratory set-up designed for the preparation of thin magnetic films by electro-deposition, this technician is attaching a lead to the cathode in the plating solution. (Experimental rig at Remington Rand Laboratories.)

Thin Film *(Continued)*

field is removed, the dipoles fall to the desired 'one' or 'zero' state, after which the information field can be terminated.

Distributed Components

Resistor-capacitor networks are ideal for the exploitation of the thin-film techniques of evaporation of conductors and dielectrics. Similar effects can be produced in single crystal silicon using the p-n junction capacitor with the bulk material acting as the distributed resistor. A significant difference between the two methods is that the semiconductor distributed circuit is voltage sensitive, the applied field varying the width of the depletion layer and hence both the capacity and resistance values. The distributed R-C component has had some success experimentally in phase shift oscillators and it is to be hoped that circuit designers will give their attention to other outlets for this interesting component.

Circuits in Solids

Two essentially different techniques for making passive components have been described. One of these seeks to compress them into two-dimensional areas and the other to create them as regions within a solid. Each of these is likely to find a place in the developments of the immediate future but there is a temptation to conclude that in the long run, processes which are compatible with the production of active as well as passive components are the ones most likely to stand the test of time. The realization of simple circuit functions inside a solid is within reach and has in fact been demonstrated experimentally. Beyond this one hesitates to predict, the more so since there are signs that a section of the popular press is becoming dangerously impatient with the lack of continuity in the hand-out of sensational results. The technical difficulties ahead are indeed great and the problems of process control formidable and as yet unsolved and even undefined. But the prize in terms alone of elimination of interconnections and individual encapsulation is so great that research effort in this field is on a considerable scale in many places. An evolution is in progress which will have profound effects upon this industry.

Special Networks

Deposited L-C networks are in the same class of difficulty as ordinary thin-film lumped inductance. About the only simple example is the pancake air core coil deposited as the counter-electrode of a deposited and anodized tantalum capacitor.

Transformer-like thin-film configurations have been proposed but both distributed L-C and thin-film passive impedance transformation for integrated circuitry are in the early experimental state.

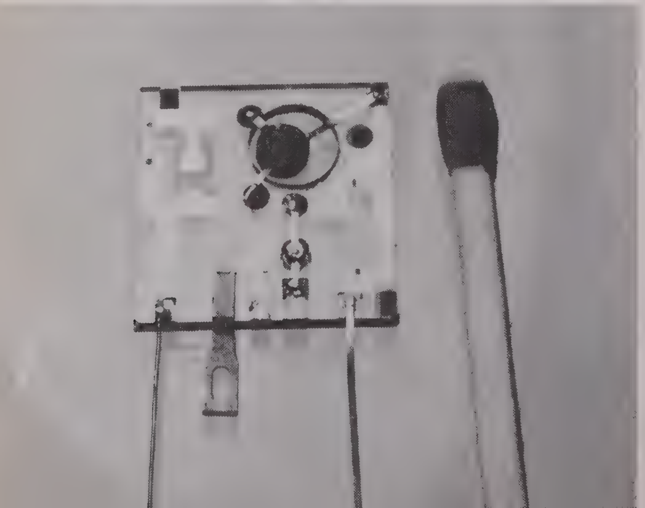
Diffused back-biased R-C networks are similar to the thin-film extrinsic kind except that they are voltage sensitive as to their capacitance and sometimes even their resistance. If the current-carrying diffused layer is thin enough, or if the back-biased junction is between the parent substrate and a thin current carrying epitaxial layer, variation of the reverse-biasing voltage will affect both the series resistance of the thin layer and the shunt capacitance to the substrate. Such a configuration can form a tuning unit in a phase-shift oscillator or feedback amplifier.

Bulk resonance effects such as the piezoelectric resonance of specially cut quartz crystals are classed as intrinsic special networks even though they normally occur in other than semiconducting substrates. In the case cited, the mechanical motion of the crystal would probably be disastrously damped by using it as the substrate for other integrated circuits, but it is conceivable that thin-film circuits could be laid entirely along nodal lines.

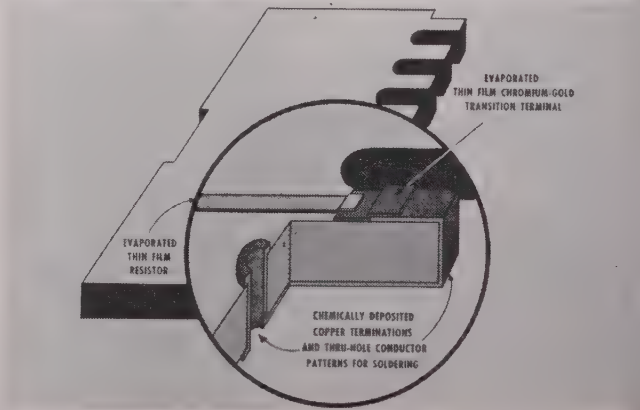
Substrates

Glass is used because of its excellent surface. No ceramic, however highly polished, has a surface comparable in smoothness with glass. The glass

Soldered, clip-on, and welded leads in this glass-substrate inverter microcircuit demonstrate versatility of inter-connection formats in CBS Electronics program.



Using special transition films of gold and chromium, CBS Electronics has successfully produced thin-to-thick film bonds which exhibit a high order of reliability.


EVAPORATED THIN FILM CHROMIUM-GOLD TRANSITION TERMINAL
EVAPORATED THIN FILM RESISTOR
CHEMICALLY DEPOSITED COPPER TERMINATIONS AND THRU-HOLE CONDUCTOR PATTERNS FOR SOLDERING

used should have a low soda content as sodium ions may leach out from the interior of the substrate to the surface under high heat, humidity, and applied voltage, and subsequently affect resistor stability. Ionic conduction may also take place at temperature reached in some of the evaporation processes where the substrate is heated at some 350°C. Specially developed boro-silicate glasses are therefore used, being accurately moulded, and optically ground and polished on one or both sides. Although standardization of substrate size is impracticable at the moment, two sizes in particular have been found to be adequate for most current circuit work. One is a small substrate of 1.5 cm^2 and the other a larger rectangular substrate 3 cm x 2 cm.

Active Elements and Substrates

Vapor deposition of semiconductor active elements on a passive substrate is undoubtedly the most important extrinsic technique in this category.

To date, no one has reported on the deposition of large-area nondegenerate single-crystal thin-films of semiconducting material on an insulating substrate (see photovoltaic cells). When this technique is fully developed it will be possible not only to build complex active functions, but to build them on either active or passive substrates as the situation dictates. One of the most important consequences following on the eventual achievement of the thin-film deposition of active semiconductor elements will be the removal of the topological-electrical limit to the number of active elements that can be built into one semiconductor substrate. Another will be a decrease in the minimum capacitive coupling attainable in an integrated circuit.

Vapor deposition of non-semiconductor active elements on a passive substrate can make useful many previously overlooked solid state effects. Both ferroelectric and ferromagnetic materials are unique in that certain of their basic properties, such as dielectric constant or permeability, can be readily changed by the application to the material of an electric or magnetic field of the proper magnitude. This property has been utilized in microcircuits for the purpose of circuit tuning. When the problems of the deposition of coherent films of these materials are overcome, an entirely new generation of active circuit elements will be possible, utilizing the nonlinear properties of ferroelectrics and ferromagnetics to actively tune circuits, act as bandpass filters, etc.

Epitaxial techniques of growing silicon layers on silicon parent stock are among the most promising tools in the area of three-dimensional integrated circuits. Vapor phase epitaxially oriented overgrowth was first developed in Europe and has since been intensively studied and applied by American materials and components manufacturers.

The epitaxial process permits a number of desirable improvements over conventional active element technology. The previous requirement with active semiconductor substrates that the active elements be fabricated within the substrate becomes within, or on the substrate. The substrate can now be a lower resistivity than could be tolerated when it had also to form the collector junction of our active elements. Large-area step junctions are now much more nearly a reality and the only diffusion effects are those occurring at the junction while the epitaxial layer or layers are being grown.

There are many facets of the process that need exploration and development, but the prospective rewards are great—both from the standpoint of new and hitherto unfeasible active and passive elements and from the standpoint of logical extension to automated, low cost, and highly flexible integrated circuit assembly processes.

Ferrite Substrates

The utilization of ferrite substrates offers a unique method of introducing an inductive element into the circuit. The requirements of such a substrate are those which must be met by any substrate, such as surface smoothness, compatability of thermal expansion and thermal conductivity with other active elements and physical strength. The use of a magnetic substrate imposes additional requirements. Magnetostrictive effects might present the problem of maintaining a bond between the substrate and the deposited films, as well as changing the electrical properties of the film through air electrostrictive properties.

In order to take full advantage of a magnetic substrate, the magnetic properties of the material must be matched to the particular requirements. For inductive purposes a low loss, high permeability material would be required, suitable for use at the frequency of interest. The temperature coefficient of permeability might be important where large fluctuations of the ambient temperature are anticipated.

The geometry of the substrate would depend upon the method used to couple the magnetic field into the circuit. One method consists of laying down the coil as a thin-film on the surface. Another consists of providing holes in the substrate through which, or around which, wires can be wound.

Capacitors

Extremely thin ceramic films, in disguise, have long been used as the dielectric of the aluminum electrolytic capacitor. In the environment of the electrolyte this film of oxide has an enormous breakdown voltage and is self-healing. Its structure has been the subject of detailed electron microscope and electron diffraction studies as part of a program to eliminate the major defect of the capacitor by replacing the liquid electrolyte with a solid electronic conductor or semiconductor. This has met with only limited success, and research has been directed instead to the corresponding problem in the tantalum electrolytic. The brilliant anodic colors are characteristic of a critical thickness of a dielectric or high refractive index in contact with a metal of poor reflectivity. They demonstrate the ability of the anodic process to produce dielectric films of extraordinary uniformity, deep within the interior of this finely porous body, for if a compact is broken open, the color is found to be the same all the way through.

(*Continued on following page*)

Thin Film *(Continued)*

Both the foil and the porous types of tantalum capacitor have been developed to a high degree, the former, until recently, having a slight advantage of somewhat higher operating voltage up to 300 v. and the latter a rather wider temperature range. Now, following research into the structure of the oxide film, it has been found possible to raise the operating voltage of the porous anode to the same level as foil and in the near future it is to be expected that the voltage limit of porous anode types will be steadily increased.

Capacitance and Materials

A number of methods have been developed for providing integrated circuit capacitance. Capacitance may be provided intrinsically by reverse-biased semiconductor junctions, by self-biased junctions or extrinsically by deposited thin-film capacitors using gold or some other conducting film as a counterelectrode.

Anodized tantalum, titanium, aluminum, or Niobium can be used to form the lower conducting layer and dielectric of deposited thin-film capacitors. After the desired thickness of dielectric has been formed, a counterelectrode of some conducting material is deposited to complete the capacitor. The films are generally deposited by evaporation or sputtering. Subsequent anodization can be controlled to a high degree and pinholes cleared before deposition of gold as the counterelectrode. Ratings of 5.0 v. microfarads per square centimeter at 50% of breakdown voltage are now a state of the art.

Titanium, aluminum, and Niobium can also be anodized with useful characteristics. Aluminum oxide has a dielectric constant less than 25% that of tantalum but has almost twice the working voltage for the same forming voltage. Unless the counterelectrode is of the same material as the anodized material, this type of capacitor is polar.

Deposited metal oxide glasses can be sandwiched between deposited conductors to form an alternative thin-film capacitor. Here the dielectric constant is much lower than either of the anodized dielectrics mentioned above but the use of low melting silicate type glasses avoids some of the problems of the anodized capacitor process. Deposited metal oxide glass dielectric capacitors can be fabricated at lower temperatures than are required in the deposition of tantalum.

Deposited ferroelectrics offer attractive possibilities as dielectrics for thin-film capacitors. Chief among the attractions is a dielectric constant for barium titanate three orders of magnitude greater than that for the silicate type glasses. Such a dielectric might also have important contributions stemming from its nonlinearity and polarization nature. The chief disadvantages appear to be a limited operating range of temperatures and instability or deterioration of electrical properties. Work with deposited ferroelectrics is in the early exploratory stage. *(To be continued next month)*

By JAMES C. LOONEY
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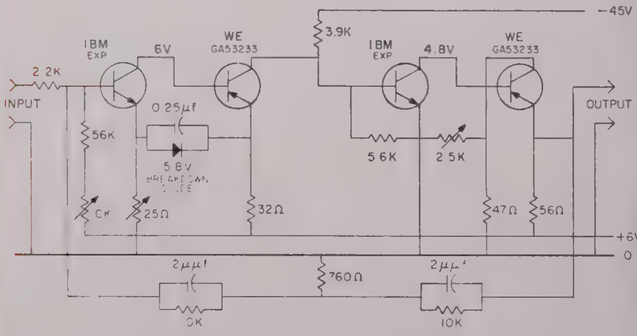
How to . . .
Analyze

AN ESIAC algebraic computer can be used to make the analysis of a multi-loop feedback amplifier relatively easy. The stability characteristics of the amplifier can be obtained from root-locus plots and the steady-state frequency response characteristics can be determined with Bode plots. In the following analysis, the effects of positive feedback in a transistor amplifier are determined from root-locus and Bode plots made by an ESIAC computer.

Analyzing the Amplifier

Fig. 1 shows the circuit diagram and block diagram of a four-stage, multi-loop feedback, transistor current amplifier. The interesting feature of this ampli-

Fig. 1A: Direct coupled transistor amplifier has two internal positive feedback loops as well as one overall negative feedback loop.



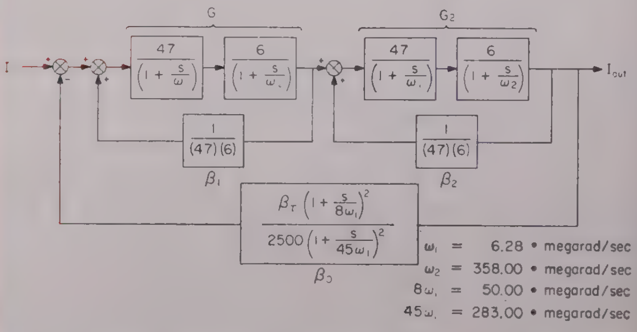

G
G2
I
$\frac{47}{\left(1+\frac{s}{\omega}\right)}$
$\frac{6}{\left(1+\frac{s}{\omega_1}\right)}$
$\frac{47}{\left(1+\frac{s}{\omega_1}\right)}$
$\frac{6}{\left(1+\frac{s}{\omega_2}\right)}$
I_{out}
$\frac{1}{(47)(6)}$
β_1
$\frac{1}{(47)(6)}$
β_2
$\frac{\beta_T\left(1+\frac{s}{8\omega_1}\right)^2}{2500\left(1+\frac{s}{45\omega_1}\right)^2}$
β_3
ω_1 = 6.28 • megarad/sec
ω_2 = 358.00 • megarad/sec
$8\omega_1$ = 50.00 • megarad/sec
$45\omega_1$ = 283.00 • megarad/sec

Fig. 1B: Transfer functions of individual stages are in the blocks.

The performance of multi-loop feedback amplifiers can be improved using positive feedback. Harmonic distortion and sensitivity to parameter variations can be reduced, signal-to-noise ratio can be increased, and input and output impedance can be made either high or low. Using positive feedback in general results in a conditionally stable amplifier. A thorough analysis is needed to insure stable operation with adequate phase and gain margins.

Feedback in Transistor Amplifiers

fier is that it has two internal positive feedback loops as well as one overall negative feedback loop.

With Positive Feedback

The transfer functions of the individual stages are shown in the blocks (Fig. 1B). A transfer function is defined as the ratio of an output quantity to an input quantity. The overall current transfer function of the amplifier from the input to the output, $\frac{I_{out}}{I_{in}}$, is found by repeated application of the familiar feedback equation[2] $\frac{G}{1+\beta G}$ where G is the transfer function of a feedforward branch and β is the transfer function of a feedback branch. The overall closed-loop transfer function of the amplifier is then given by:

$$\frac{I_{out}}{I_{in}} = \frac{\left(\frac{G_1}{1+\beta_1 G_1}\right)\left(\frac{G_2}{1+\beta_2 G_2}\right)}{1+\beta_0\left(\frac{G_1}{1+\beta_1 G_1}\right)\left(\frac{G_2}{1+\beta_2 G_2}\right)} \qquad (1)$$

which simplifies to:

$$\frac{I_{out}}{I_{in}} = \frac{G_1 G_2}{(1+\beta_1 G_1)(1+\beta_2 G_2) + G_1 G_2 \beta_0} \qquad (2)$$

After inserting numerical values and simplifying, Equation (2) becomes:

$$\frac{I_{out}}{I_{in}} = \frac{(282)^2}{\left[\left(1+\frac{s}{6.28}\right)\left(1+\frac{s}{358}\right)-1\right]^2 + \frac{\beta_\tau (282)^2 \left(1+\frac{s}{50}\right)}{2500\left(1+\frac{s}{283}\right)^2}} \qquad (3)$$

using units of megaradians per second for s and ω.

The characteristics of this amplifier such as stability, damping, and frequency response are completely specified by the poles and zeros of its transfer function. The poles and zeros are easily recognized if the transfer function is put in the form of a ratio of factored polynomials. Then the zeros are the values of s that make the individual numerator factors equal to zero and the poles are the values of s that make the individual denominator factors equal to zero.

The problem now is to put Equation (3) in the form of a ratio of factored polynomials. To begin, the first term in the denominator can be factored by multiplying and collecting terms to give:

$$\left(1+\frac{s}{6.28}\right)\left(1+\frac{s}{358}\right) - 1 = \frac{1}{6.2}\, s\left(1+\frac{s}{365}\right) \qquad (4)$$

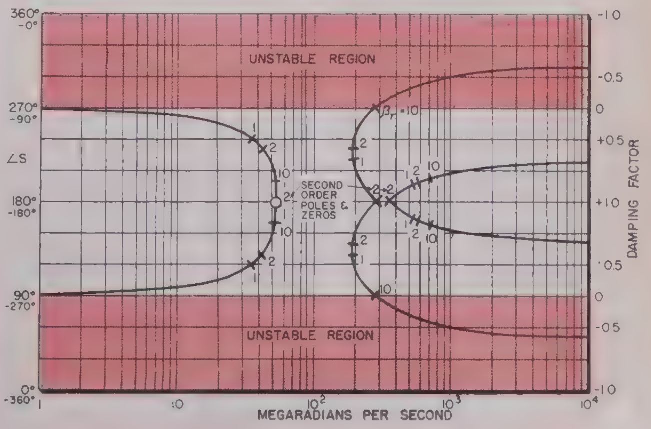
Then, substituting it into the transfer function gives:

$$\frac{I_{out}}{I_{in}} = \frac{(282)^2}{\left(\frac{1}{6.2}\right)^2 s^2\left(1+\frac{s}{365}\right)^2 + \beta_\tau \frac{(282)^2\left(1+\frac{s}{50}\right)^2}{2500\left(1+\frac{s}{283}\right)^2}} \qquad (5)$$

or

$$\frac{I_{out}}{I_{in}} = \frac{(282)^2\, 2500\left(1+\frac{s}{283}\right)^2}{\frac{2500}{(6.2)}\, s^2\left(1+\frac{s}{365}\right)^2\left(1+\frac{s}{283}\right)^2 + \beta_\tau (282)^2\left(1+\frac{s}{50}\right)^2} \qquad (6)$$

Fig. 2: Root locus plot including positive feedback loops. Closed-loop pole locations for indicated values of β_τ.



Positive Feedback *(Continued)*

Now solve for the roots of the denominator by setting it equal to zero and rearranging to give:

$$-1 = \frac{\beta_T\,(1210)\left(1+\frac{s}{50}\right)^2}{s^2\left(1+\frac{s}{365}\right)^2\left(1+\frac{s}{283}\right)^2} \qquad (7)$$

which is the form of the general equation for programming the ESIAC. Fig. 2 shows the ln s-plane root locus plot for finding the values of s which satisfy the above equation for various values of β_T. The plot shows that the amplifier will oscillate if β_T is larger than 10. A reasonable choice would be $\beta_T = 1$. The closed-loop pole locations are then:

$$\begin{aligned} s = {} & 36 \angle 120^\circ,\ 36 \angle -120^\circ, \\ & 190 \angle 140^\circ,\ 190 \angle -140^\circ, \\ & 540 \angle 165^\circ,\ 540 \angle -165^\circ \end{aligned}$$

Substituting these factors in Equation (3), the closed-loop transfer function for the amplifier becomes:

$$\frac{I_{out}}{I_{in}} = \frac{(282)^2\,(2500)\left(1+\frac{s}{283}\right)^2}{\beta_T\,(282)^2\left(1-\frac{s}{540\angle 165^\circ}\right)\left(1-\frac{s}{540\angle -165^\circ}\right)\left(1-\frac{s}{190\angle 140^\circ}\right)\left(1-\frac{s}{190\angle -140^\circ}\right)\left(1-\frac{s}{36\angle 120^\circ}\right)\left(1-\frac{s}{36\angle -120^\circ}\right)} \qquad (8)$$

The ESIAC can plot the magnitude and phase versus log frequency curves, (Bode Plots) by setting $s = j\omega$. These will show the steady-state frequency response of the amplifier with positive feedback. The curves labeled "With Positive Feedback" in Fig. 3 and 4 show these Bode Plots.

Without Positive Feedback

For comparison purposes, the amplifier frequency response without the internal positive feedback loops is determined. The closed-loop transfer function without positive feedback is

$$\frac{I_{out}}{I_{in}} = \frac{G_1\,G_2}{1+G_1\,G_2\,\beta_0} = \frac{\dfrac{(282)^2}{\left(1+\frac{s}{\omega_1}\right)^2\left(1+\frac{s}{\omega_2}\right)^2}}{1+\dfrac{(282)^2\,\beta_T\left(1+\frac{s}{8\,\omega_2}\right)^2}{2500\left(1+\frac{s}{\omega_1}\right)^2\left(1+\frac{s}{\omega_2}\right)^2\left(1+\frac{s}{45\,\omega_1}\right)^2}} \qquad (9)$$

where $\beta_1 = \beta_2 = 0$. With numerical values:

$$\frac{I_{out}}{I_{in}} = \frac{(2500)\,(282)^2\left(1+\frac{s}{283}\right)^2}{(2500)\left(1+\frac{s}{6.28}\right)^2\left(1+\frac{s}{358}\right)^2\left[\left(1+\frac{s}{283}\right)^2+(282)^2\,\beta_T\left(1+\frac{s}{50}\right)^2\right]} \qquad (10)$$

The roots of the denominator of Equation (10) are found with the ESIAC by solving the equation:

$$-1 = \frac{3.18\,\beta_T\left(1+\frac{s}{50}\right)^2}{\left(1+\frac{s}{6.28}\right)^2\left(1+\frac{s}{358}\right)^2\left(1+\frac{s}{283}\right)^2} \qquad (11)$$

Fig. 5 shows the resultant root-locus plot on the ln s-plane. The plot shows that the amplifier will oscillate for $\beta_T > 100$. A value of $\beta_T = 0.97$ is chosen so that the dc gain of the closed loop amplifier will be the same, both with and without the positive feedback loops. For this value of β_T, the closed-loop pole locations are found in Fig. 5 to be:

$$\begin{aligned} s = {} & 12 \angle 135^\circ,\ 12 \angle -135^\circ, \\ & 240 \angle 163^\circ,\ 240 \angle -163^\circ, \\ & 430 \angle 172^\circ,\ 430 \angle -172^\circ \end{aligned}$$

The closed-loop transfer function without positive feedback is then:

Fig. 3: Amplifier phase response versus frequency.

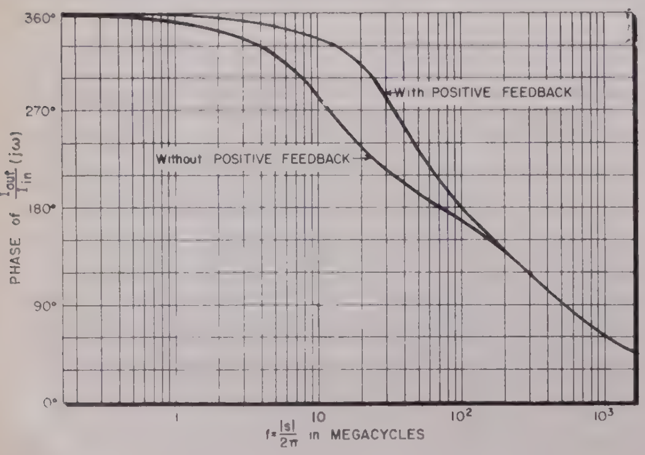
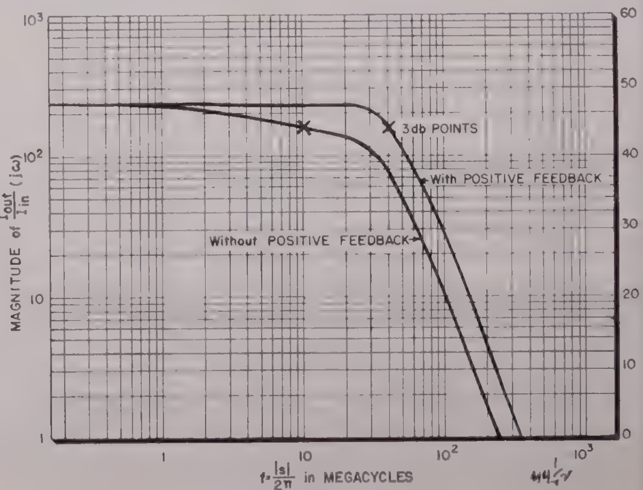


Fig. 4. Amplifier magnitude response versus frequency.



$$\frac{I_{out}}{I_{in}} = \frac{2500\left(1+\frac{s}{283}\right)^2}{\left(1-\frac{s}{12\angle 135^\circ}\right)\left(1-\frac{s}{12\angle -135^\circ}\right)\left(1-\frac{s}{240\angle 163^\circ}\right)\left(1-\frac{s}{240\angle -163^\circ}\right)\left(1-\frac{s}{430\angle 172^\circ}\right)\left(1-\frac{s}{430\angle -172^\circ}\right)} \quad (12)$$

For $s = j\omega$, the Bode Plots of the amplifier without positive feedback are plotted with the ESIAC. These curves are shown in Figs. 3 and 4 and are labeled "Without Positive Feedback."

Fig. 4 shows that a 4 to 1 improvement in frequency response at the 3 db point can be obtained by using positive feedback in this amplifier.

Varying Transistor Gain

Next the effects of a variation in gain of the transistors is investigated. Let A equal the ratio of the gain after variation to the gain before variation. An $A = 1.2$ would mean that the gain has increased by 20%. Assume also that A is associated with the first stages of the amplifier. The closed-loop transfer function is then:

$$\frac{I_{out}}{I_{in}} = \frac{A\,G_1\,G_2}{(1+A\,G_1\,\beta_1)(1+G_2\,\beta_2)+A\,G_1\,G_2\,\beta_0} \quad (13)$$

$$= \frac{A\,(282)^2\,(2500)\left(1+\frac{s}{283}\right)^2}{2500\left[\left(1+\frac{s}{6.28}\right)\left(1+\frac{s}{358}\right)-1\right]\left[\left(1+\frac{s}{6.28}\right)\left(1+\frac{s}{358}\right)-A\right]\left(1+\frac{s}{283}\right)^2 + A\,(282)^2\,\beta_\tau\left(1+\frac{s}{50}\right)^2} \quad (14)$$

After factoring the terms in brackets on the left side of the denominator this becomes:

where

$$\alpha = -182 + 1125\sqrt{0.0263 - 0.0178\,(1-A)}$$

$$\gamma = -182 - 1125\sqrt{0.0263 - 0.0178\,(1-A)}$$

The closed-loop pole locations are found by solving for the roots of the denominator of Equation (15). Begin by setting the denominator equal to zero to get:

$$\frac{\beta_\tau\left(\frac{A}{1-A}\right)\left(1+\frac{s}{50}\right)^2}{s\left(1-\frac{s}{\alpha}\right)\left(1-\frac{s}{\gamma}\right)\left(1+\frac{s}{365}\right)\left(1+\frac{s}{283}\right)^2} = -5.1\cdot10^{-3} \quad (16)$$

Since α and γ are functions of A, and there are two variables, A and β_τ, the solution of Equation (16) will be a family of curves. These root-locus plots are shown in Fig. 6. Also shown in Fig. 6 are the closed-loop pole locations for $\beta_\tau = 1$ and various values of A. Notice that, with $\beta_\tau = 1$, the amplifier is stable until A approaches 10. This represents a 20 db increase in open-loop gain. If the open-loop gain is decreased, the amplifier never becomes unstable.

The closed-loop pole locations are easily determined from the curves for any desired value or range of values of A and β_τ. When this is done, the stability characteristics of the amplifier are apparent from Fig. 6.

The frequency response curves could then be plotted with the ESIAC to give the steady-state characteristics of the amplifier. If the time-domain transient response is desired, the ESIAC can be used to find the residues at the closed-loop pole locations.[3] After the residues are known, the equation for the time-domain response can be written by using conventional Laplace Transform Techniques.

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$$\frac{I_{out}}{I_{in}} = \frac{A\,(282)^2\,(2500)\left(1+\frac{s}{283}\right)^2}{(1-A)\left(1-\frac{s}{\alpha}\right)\left(1-\frac{s}{\gamma}\right)\left(\frac{s}{6.2}\right)\left(1+\frac{s}{365}\right)\quad\left(1+\frac{s}{283}\right)^2 2500 + A\,(282)^2\left(1+\frac{s}{50}\right)^2\beta_\tau} \quad (15)$$

Fig. 5: Root locus plot without positive feedback loops. Closed-loop pole locations for indicated values of β_τ.

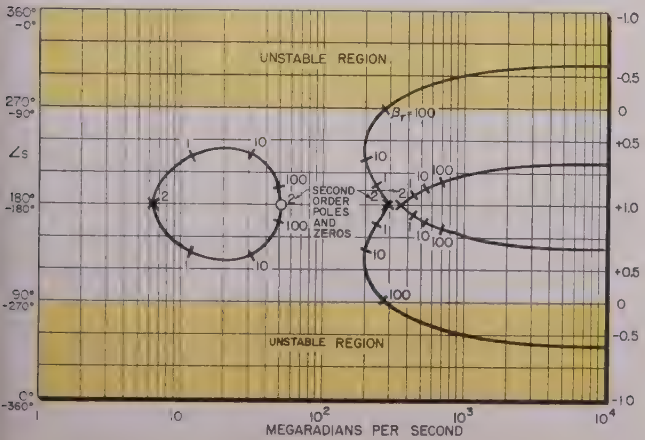
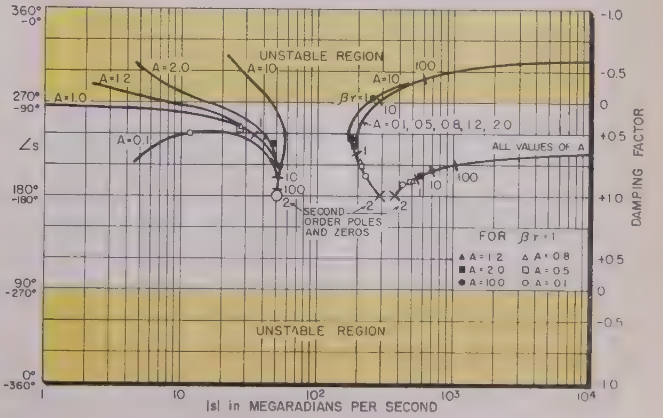


Fig. 6: Root locus plot including positive feedback loops. Closed-loop pole locations for indicated values of A and β_τ.



At High Frequencies . . .

Recent Advances

By W. J. POLYDOROFF

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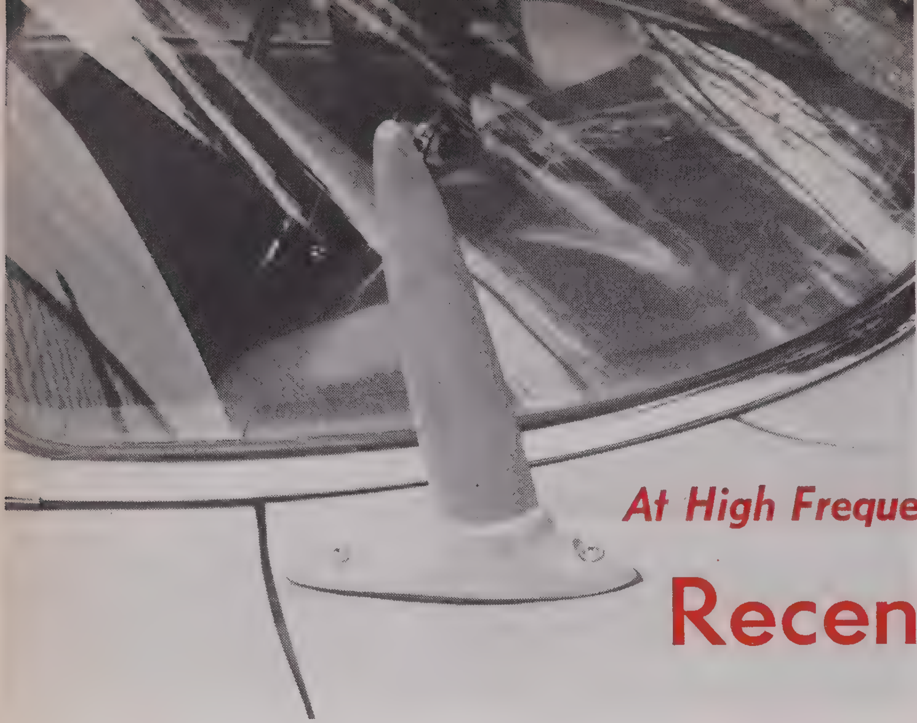

Fig. 1: A broadcast FM antenna has been designed for automobiles that makes use of new ferrite technology.

RECENT developments in ferro-ceramic cores, known as "ferrites," open many new applications, especially in the field of microwaves. But the increased permeability with low losses is equally applicable to normal employment of magnetic materials in inductors and loop antennas, particularly at very high frequencies. Some progress in this art may be of interest to the technical world.

There is still a continuous demand and interest in ferromagnetic antennas. With the increased speed and altitudes of aircraft, projections on the outer surface caused by loop installations, no matter how greatly reduced from the old days, are no longer tolerated.

High permeability ferrites offer a low reluctance path to the magnetic component of radio signals. There are at least two methods known for using this effect in the close vicinity of reflecting metal surfaces of an airborne vehicle.

Direction Finders

One method[a] consists of placing four long ferrite bars, in the form of an X, in the vehicle's skin. A rotating goniometer is placed in the center of the X. The azimuthal sensitivity of such a collector is not uniform. It varies, in a sinusoidal manner, with bearings in respect to the aircraft. Also, long bars require considerable "flat" surface on the skin, which adversely affects streamlining contours of a plane.

Another system, as proposed in my book[b] and now in use, has a relatively small sunken pan that contains a rotating ferrite loop surrounded by stationary ferrite members which form a "collecting means" to reinforce the reception. The location of fixed ferrite members may also correct the error. Additionally, with new z-shaped loop (also described in the book) it is possible to combine both uniform reception and flush installation in a container, not over a foot in diameter. This allows a stationary vertical loop without commutation, thus greatly simplifying the problem of immunity to sudden atmospheric changes. In this case, rotating ferrite members accomplish directional effects.

The major application of ferrite loops is within a frequency range of 0.2 to 2.0 MC, both for aircraft and broadcast bands. Little work has been done in extending the range of applications beyond this range, although experimental and some defense applications went up to the limit of 20 MC. Beyond this Adcock antennas served as directional collectors.

FM Reception

With the advent of ferrites of excellent loss characteristics (Q over 100) at the frequencies of 100 MC, it became theoretically possible to employ vertical loops for FM reception, which by their small size would be welcomed on automobiles. Additionally, omnidirectional reception of signals, regardless of bearing on the station, should be expected.

An FM signal frequency around 100 MC, horizontally polarized, requires a short horizontal dipole. The antenna is efficient but rarely employed in cars. A poor substitute is the small vertical monopole universally used. In a great majority of cases the emitted FM wave contains some vertical component of polarization, resulting either from a poorly designed antenna system or from reflections from ionosphere and other obstacles. Reception is thus possible with the above

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[a] Telefunken, German Patent 219,970.

[b] W. J. Polydoroff, *H. F. Magnetic Materials, Their Characteristics and Principal Applications*—Wiley & Sons.

Here are some of the latest applications of magnetic materials at all frequencies now in use. Some of the interesting applications are a "no silhouette" aircraft antenna, a small FM broadcast antenna for cars and a compact, low cost TV tuner.

in Ferromagnetics

mentioned monopole.

It is a long step from theory to practice, especially to separate the magnetic reception from the inevitable electric components of the scattered wave. As we know from various loop investigations, the coil antenna, unless properly shielded, or "screened," and the windings juxtaposed, a noticeable "antenna effect" masked the directional property of vertically polarized signals. These effects are particularly pronounced at frequencies in the order of 100 MC. At these high frequencies, the loop antenna's inductance and self capacity must be exceedingly small so its natural frequency is above the highest frequency of the range. A further limitation appears when such an antenna is coupled to the receiver's input by a cable. Practical impedance of this cable is 300 ohms. The higher impedance presents additional cost and bulkiness. The antenna circuit impedance should substantially match the line.

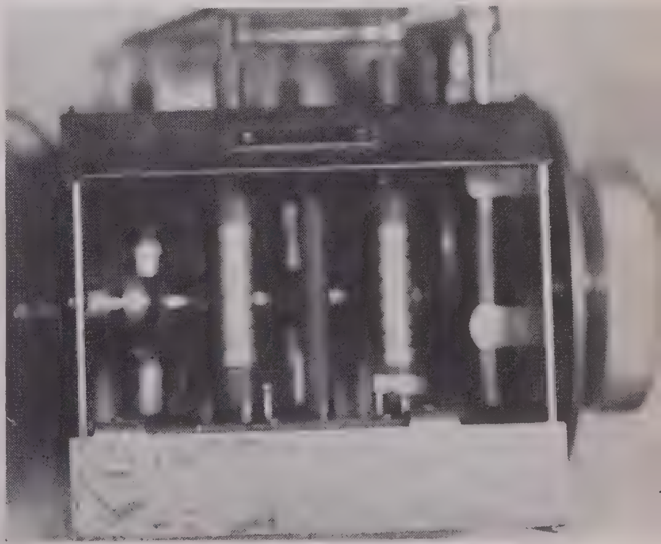
Automobile Antenna

All of these difficulties were finally overcome by Mr. R. R. Walsh of All American Engineering Co., who, in cooperation with me finally produced a workable commercial sample of an auto antenna. This antenna matches the impedance of the cable and the input of the majority of FM auto receivers. Fig. 1 shows one such antenna mounted vertically on the fender of an automobile. A ½ in. dia., 8 in. long ferrite rod is employed. It has a special winding[c] arranged to cancel the electric component of the wave and to produce sufficient coupling between the core's winding.

A resultant "effective height" favorably compares with vertical whips now in use. The proof of its magnetic pick-up can be easily demonstrated by positioning the antenna horizontally and observing the attenuation. The zero signal is observable when a wave of horizontal polarization, with no scatterings or reflections, is available. As should be expected, the reception is omnidirectional. In specific locations, where the electric component is greatly attenuated, such as a network of overhead wires, short overhead bridges, entrances into tunnels, etc., the loop reception scores over the conventional antenna.

I extended the use of this antenna to TV reception. It works satisfactorily on lower frequency channels and very poorly around 200 MC., where the inductance value of the loop has to be reduced four times, thus reducing the winding of the antenna to less than one turn. During all of these investigations, we have learned that considerable improvement may result if the loop antenna is individually tuned (or made resonant) to a signal. Unfortunately this would call

Fig. 2: New TV tuner design uses only 3 ferrite core coils instead of the normal 30 or so coils in today's tuners.



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[c] U. S. Pat 2-354,332.

Ferromagnetics *(Concluded)*

for a redesign of the input end of the majority of existing FM receivers.

Thus we have learned how to use the magnetic component of radio signal of horizontal polarization with a vertical loop providing omnidirectional reception. In this connection, it is proper to evaluate underwater reception of very low frequency signals of vertical polarization by means of ferromagnetic loop collectors. There this component is parallel to the surface of the sea, which explains the enormous difficulties of underwater communications. Since when the wave and its horizontal magnetic force strikes the surface, great initial attenuation occurs before the remnants of the energy are transmitted to the depth and then received by a horizontal loop antenna. One way to overcome this attenuation is to increase the transmitting power a thousand fold. Another would be to change the direction of polarization. In both cases a loop collector is to receive the signal, the difference being in its shape and position. It is realized that this suggestion will result in great difficulties in antenna design for l-f horizontal polarization. But the great savings in power requirements may justify the experiment.

TV Applications

Again these advances in ferrite materials in the very high frequency field offered several opportunities in permeability tuning, hitherto not possible with comminuted cores at those frequencies. While the latter have initial permeability of the order of 3 to 4, new ferrites attain 13-14 with approximately the same core loss of Q_i. In either material. with a few turns of wire, it is possible to attain a combined Q of well above one hundred. While comminuted cores could be employed in FM and coaxial tuning to cover required limited ranges, their employment in TV circuits compelled early designers to restrict tuning to each individual TV range separately. This required either two distinctly separate coils and cores for the lower range and coaxial tuning for the upper. In both cases switching was required, which is a handicap.

I investigated the possibility of permeability tuning for TV receivers using new ferrites[d] and, together with other simple means, found a way to cover the entire range, 55 to 225 MC, with a single sweep of a core movement. Very compact tuners will be ultimately available employing just 3 coils and 3 cores with a reliable mechanical movement translated into a tuning dial. The linear scale is out of fashion; tuning by a pre-set channel knob requires a precision mechanism for dial indication. This would somewhat increase the cost of a tuner, but not enough to offset the savings of using 3 coils and no switching contacts against 30 or so coils with accompanying 60 contacts in an average TV tuner.

At least in metropolitan areas, the FM reception is now generally accepted and used in preference to AM. The new tuner covering the entire range, from 55 to 225 MC, provides automatically, free FM reception in a TV receiver with a single optional switch to disable the picture tube while on FM.

Another valuable application of new ferrites is in tuned coaxial lines. A copper tubing of ¼ in. inner diameter with a central coaxial lead has an inductance of about 0.03 microhenry.

$$L = 2 \log_e \frac{D}{d} \times 10^{-9} \cdots \text{henry/cm}$$

Moving in a slotted core 1½ in. long produces a frequency tuning of over one octave. This small inexpensive device may find its applications in higher VHF ranges such as now being used in aircraft radio.

The microwave applications of ferrites are well known and cover the range approximately from 1 KMC up to 10 KMC (Bands L,S,O,X) where the function of ferromagnetic materials are entirely different. Suffice to say that in these applications the "real" component of "tensor permeability" is less than unity, while permeability per se, measured by conventional methods at lower frequencies, may be of the order of 7 to 10.

We have thus, in a relatively short span, covered the useful application of magnetic materials at all frequencies now in use. There remains a short gap of the UHF spectrum 450 to 900 MC, an extended TV band of channels. There is no doubt that this band of one octave will also eventually be covered by application of magnetic materials, using, for instance, the saturation effect by placing ferrite in resonant cavities. Such an arrangement is being described already in several patents.

So far we have briefly touched the subject of employment of magnetic materials in electronic devices. There remains a tremendous field for progress in applications of ferromagnetic in the propagation, deflection, collection of radiated field, which required an intensive and expensive research.

EDITOR'S NOTE:

For more information about ferromagnetic materials & applications we suggest that you see the following articles published in Electronic Industries.

J. L. Kiser, "The Electrically Variable Inductor," June 1961

W. J. Polydoroff, "Magnetic Field Antenna," March 1958

A. B. Przedpelski, "Simple Circuit Stabilizes Ferrite FM Modulator," Feb. 1958

A. O. Adams, "Magnetic Amplifier Operated Relays," Dec. 1958

A. B. Przedpelski, "Reversing Ferrite Temperature Coefficients," Nov. 1958

Dr. E. Wantuch, "High Power Testing of Ferrite Isolators," Apr. 1958

I. L. Auerbach, "Applications of Bistable Ferromagnetic Elements," Apr. 1956

M. B. Loss, "Broadband Applications of Ferrites," Feb. 1956

REFERENCE PAGES

The pages in this section are perforated for easy removal and retention as valuable reference material.

SOMETHING NEW HAS BEEN ADDED

An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

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[d] Q-3 of General Ceramic Co.

Burn-in to remove early failures—
and increase reliability—has long been accepted.
But what is the proper stress to place upon the components?
What voltage? What temperature? And, for how long?
Here are the details on an answer-seeking study
for glass dielectric capacitors.

Determining Optimum Burn-In For Capacitors

By LAWRENCE D. HINES
Corning Glass Works
Bradford, Penna.

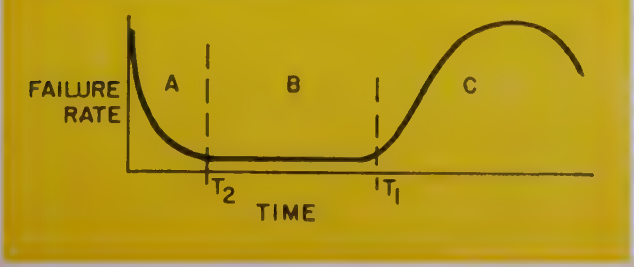
IN load life tests on fixed glass dielectric capacitors, all or most typical early failures occur in the first few hours. These results seem to indicate that a preconditioning burn-in of the device at some level of stress for some length of time would be of great value; mainly, in assuring that the "sports" would be eliminated. This optimum burn-in should get rid of those failures occurring in Area A of Fig. 1 without moving T_1 to the left.

Many users have found that a burn-in removes potential early load life failures and, therefore, causes significant decreases in total load life failure rates up to T_1. There was, however, no known optimum burn-in for fixed glass dielectric capacitors. We designed a study, Fig. 2, to provide information which would, after analysis, describe an optimum burn-in with respect to time, voltage level, and temperature.

Design of the Study

In the past, over 500,000 devices were delivered after a burn-in of 100 hours at room temperature and 150% of rated voltage. No field failures from these devices have been reported. Are these conditions optimum? The results suggested that they are in this neighborhood. The study was designed with this in mind.

Fig. 1: Elimination of failures occurring in A was the target.



Four values, two styles, of devices were used. In the CYF-10 style, the values used were 33μμf, 150μμf, and 220μμf. These values were lows and highs in the 500v-rated devices and high in the 300v-rated devices. In the CYF-15 style, the value was 470μμf, high in the 500v-rated range. These 4 selections were used in equal numbers. All devices were made in October, 1959. They do not show the quality of devices now being produced. For this reason, the study was complete within itself; the data is not meant to be used as a measure of current devices.

All devices were mounted on Fotoceram Printed Circuit Boards. The boards held 184 CYF-15 devices or 190 CYF-10 devices. The total study started with 10 full boards of each value.

During production, devices were usually given a hi-pot test of 4 times rated voltage plus 200v. Again, before shipment all devices were usually given another hi-pot test of 4 times rated voltage. We did not know whether these tests were detrimental to the devices. So, the study, Fig. 2, was designed to hi-pot half the devices at 4 times rated voltage plus 200v. The other half were hi-potted at only 45v so all dead shorts would be removed before the burn-in tests. None of these devices received the hi-pot tests normally performed during production.

We felt that the optimum burn-in voltage would not be an exact voltage; but rather, one which would be acceptable within a given range. The study, therefore, was designed to present 5 different voltages, Fig. 2.

Because of the number which would be burned-in under normal production output, we decided that the best temperature would be 25°C. All burn-in tests were conducted at room temperature with one exception. The 300% of rated voltage burn-in was conducted at −17°C.

To prove which burn-in was most effective, we used two methods. We obtained spectra at ambient temperatures of 25°C, 85°C, 125°C, and 175°C as a check against temperature effects. One thousand devices, 25 from each board were used for each group of spectra. We compared these spectra to the Control Specimens spectra from which the devices had been removed prior to the burn-in tests.

In the second method, we put survivors of the various burn-in spectra tests on an accelerated life test. The life test was conducted at 200% of rated voltage and 125°C for 521 hours; then, at 300% of rated voltage and 125°C for 479 hours. The life test stress was increased because too few devices were failing at the initial stress. We could obtain good data only with failures occurring on all boards of devices.

The study, Fig. 2, shows the actual numbers of devices entering into the specific test. A total of 40 Fotoceram Boards were used. Five boards of each value device were subjected to hi-pot tests and five were not. One board from each of these groups and of each value was subjected to one of the burn-in tests, Tests A-E. Twenty-five devices from each board then went to each spectrum test, Tests F-J. The remaining devices on each board went into the life test, Test K.

Analysis of Study

Table 1 is an ANOVA based on the percent survival of the various capacitance values/burn-in stress devices after 1000 hour on Test K. Levels A, B, and AB are significant at the 5% level. We decided to eliminate the burn-in voltages at levels less than the normal life test level of 150% of rated voltage. Therefore, the results of Tests A and B were withdrawn from consideration. The resulting ANOVA is shown in Table 2.

At the 5% level, only a significant difference in Level B remained. These results indicate that the voltage level at the burn-in tests, Test C-E, for one value of the devices was not high, or low, enough. An

Table 1

ANOVA FOR RESULTS OF TEST K

SOURCE OF VARIATION	SS	DF	MS	F	$F_{.05}$
LEVEL A	964	4	241.00	11.16	3.48
LEVEL B	2267	3	755.67	34.98	3.71
LEVEL C	1	1	1.00	–	
INTERACTIONS AB	869	12	72.42	3.35	2.91
INTERACTIONS AC	124	4	31.00	1.44	3.48
INTERACTIONS BC	36	5	7.20	–	
INTERACTIONS ABC	216	10	21.60		
TOTAL	4477	39			

Table 2

ANOVA FOR RESULTS OF TEST K LESS TESTS A&B

SOURCE OF VARIATION	SS	DF	MS	F	$F_{.05}$
LEVEL A	31	2	15.50	–	
LEVEL B	586	3	195.33	6.70	4.76
LEVEL C	9	1	9.00	–	
INTERACTIONS AB	345	6	59.50	2.04	4.28
INTERACTIONS AC	109	2	54.50	1.87	5.14
INTERACTIONS BC	40	3	13.33	–	
INTERACTIONS ABC	175	6	29.17		
TOTAL	1295	23			

Table 3

ANOVA FOR MODIFIED TEST K RESULTS LESS TESTS A&B

SOURCE OF VARIATION	SS	DF	MS	F	$F_{.05}$
LEVEL A	150	2	75.00	4.29	5.14
LEVEL B	33	1	33.00	1.89	5.99
LEVEL C	42	3	14.00	–	
INTERACTIONS AB	34	2	17.00	–	
INTERACTIONS AC	259	6	43.17	2.47	4.28
INTERACTIONS BC	23	3	7.67		
INTERACTIONS ABC	105	6	17.50		
TOTAL	646	23			

Table 4

ANOVA FOR RESULTS OF TESTS A&E

SOURCE OF VARIATION	SS	DF	MS	F	$F_{.05}$
LEVEL A	247	4	61.75	20.58	3.26
LEVEL B	111	3	37.00	12.33	3.49
LEVEL C	18	1	18.00	6.00	4.75
INTERACTIONS AB	79	12	6.58	2.19	2.67
INTERACTIONS AC	50	4	12.50	4.17	3.26
INTERACTIONS BC	15	3	5.00	1.67	3.49
INTERACTIONS ABC	36	12	3.00		
TOTAL	556	39			

Table 5

ANOVA FOR RESULTS OF TESTS A&E PLUS HI-POT

SOURCE OF VARIATION	SS	DF	MS	F	$F_{.05}$
LEVEL A	216	4	54.00	13.20	3.26
LEVEL B	655	3	218.33	53.47	3.49
LEVEL C	337	1	337.00	82.53	4.75
INTERACTIONS AB	85	12	7.08	1.73	2.69
INTERACTIONS AC	67	4	16.75	4.10	3.26
INTERACTIONS BC	231	3	77.00	18.86	4.49
INTERACTIONS ABC	49	12	4.083		
TOTAL	1640	39			

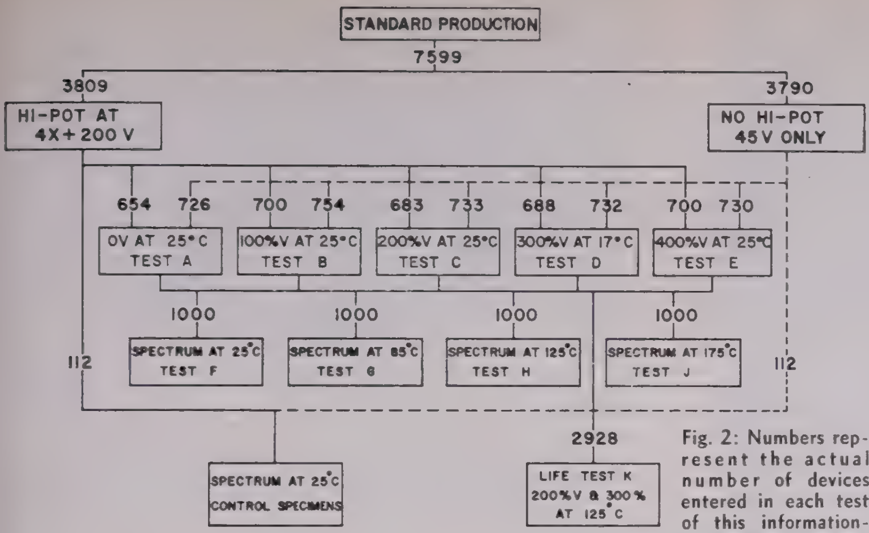


Fig. 2: Numbers represent the actual number of devices entered in each test of this information-seeking study on capacitors.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

Table 6

CORRELATION OF DEVICES COMMON TO TESTS A&F AND TEST K

ITEM COMPARED	P
$\bar{x}$	.863
$\bar{x} - \sigma$	.893
$\bar{x} - 2\sigma_1$	.952

ANOVA using only the 470μμf, 150μμf, and 33μμf devices (all rated at 500v) confirmed that there was no significant differences at the 10% level within Levels A, B, and C. The results of the 220μμf devices caused most of the significant difference in Level B of Table 2. Another ANOVA for 220μμf devices was constructed. There were no significant differences at the 10% level.

In studying the percent survivals for Test K, a good improvement in survival for the 220μμf devices appeared in those which had been in Tests D and E. A graph was drawn on linear scales of percent survival vs burn-in voltage; then, a straight line was approximated through the plots. Percent survivals were noted at the 1000, 1500, and 2000 voltages. These voltages were equal to the burn-in voltages at Tests C, D, and E for the other 3 values. In reality, the burn-in tests were based on specific voltages rather than percentages of rated voltages. The results of the ANOVA for the 220μμf devices alone seem to justify modifying both the hi-potted and not hi-potted 220μμf devices an equal amount, since there was no significant difference in Level C of that ANOVA. Using the modified percent survivals for the 220μμf devices, the ANOVA in Table 3 was computed.

Hi-Pot Effectiveness

Table 4 shows an ANOVA calculated from the percent survivals for Tests A-E. At the 5% level, there are significant differences throughout all Levels. Another ANOVA, Table 5, was computed on the percent survivals from both Tests A-E and the hi-pot tests. Much more significance was placed on Level C in Table 5 than in Table 4. Interaction BC also became much more significant. We believe that hi-potting devices, then burning them in, causes more failures than simply burning-in. Yet, in Tables 1 and 3 there appeared no significant differences in Level C from the life performance of the hi-potted and not hi-potted devices! Evidently, the hi-potting generates failures and does not merely eliminate them.

Spectrum Tests

ANOVA's were computed to check for significant differences between the means of spectra obtained in Tests F-J and the Control Specimens for each value of device. At the 5% level, there was no significant difference.

Spectra & Life Test Correlation

We need the rank difference method to find the coefficient of correlation of those devices common to Tests A and F and the survival percentage in Test K of the remaining devices from Test A. The general equation used was

$$p = 1 - \frac{6\,\Sigma\,(u - v)^2}{n\,(n^2 - 1)} \qquad (1)$$

where, p is the coefficient of correlation, u and v are corresponding rank numbers for percent survival and spectra mean, and n is the number of pairs compared. Perfect correlation is

$$p = \pm 1 \qquad (2)$$

and no correlation is

$$p = 0 \qquad (3)$$

The results are shown in Table 6.

Definitions

Level A—comparisons of results of Tests A-E

Level B—comparisons of capacitance values

Level C—comparisons between hi-potted and not hi-potted devices

ANOVA—analysis of variance

Failure—a device having dielectric breakdown

A system which can determine both the magnitude and phase angles of the Fourier components of a periodic signal is described. The system uses three basic operations: phase shift, multiplication, and averaging. An active tuned circuit provides the phase shift. A semiconductor Hall effects device is used for multiplication and averaging.

Fourier Analyzer Uses the Hall Effect

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J. D. Williams

S. P. Denker

A VARIETY of instruments have been built to determine the Fourier coefficients of signals,[1-2] but, there has been no new approach to electronic Fourier analysis since 1933, when the heterodyne method was first used commercially.[2]

Methods of Signal Analysis

The heterodyne wave analyzer (Fig. 1a) employs a variable local oscillator whose output is multiplied by the input signal. The output of the multiplier is passed directly into a selective filter. The oscillator is adjusted to make one of the beat-frequency components exactly equal the filter resonant frequency and the signal passing through the filter is detected by a simple voltmeter. In fact, the heterodyne wave analyzer is nothing more than a tunable voltmeter. Because the variable local oscillator and the input signal have uncorrelated phases and are therefore incoherent, heterodyne wave analyzers cannot measure the phase angles of the Fourier coefficients.[3] These instruments give only the magnitudes of the coefficients—phase angle information is lost.

Finding Both Coefficients

This new system for Fourier analysis of periodic signals gives both the magnitude and phase angle coefficients. The determination of the complete Fourier coefficients can be realized by the systems shown in Fig. 1b and 1c. In both systems no local oscillator or other signal source is used. Coherence of the analyzing signal with the input is achieved by dissecting the input signal into its components and multiplying them one at a time by the input wave itself.

Two methods of complete Fourier analysis have been developed. In the first (Fig. 1b), the input signal simultaneously excites a multiplier and a pulse generator. Pulses from the generator are synchronized with the input signal waveform and the pulses drive an active tuned circuit. The output from the tuned circuit, a single frequency sinusoid harmonically related to the fundamental of the input signal, is passed through a variable phase shifter. The phase shift is varied until a maximum d.c. output from the multiplier is observed. This maximum value of output signal from the multiplier is directly proportional to the magnitude of the Fourier coefficient and the phase shift is related to the phase angle of the Fourier coefficient. However, the output from the multiplier gives rather broad peaks which are hard to identify. Also, the variable phase shifter must be very elaborate.

A second system determines the Fourier coefficients by measuring their sine and cosine components. As before, the input waveform is simultaneously impressed onto the pulse generator and the multiplier. Two sinusoidal signals, harmonically related to the fundamental, are taken from the tuned circuit. One signal has zero phase shift with respect to the input waveform. The other is shifted ninety degrees with respect to the input wave. These outputs are alternately connected to the multiplier. Two readings are taken of the dc output signal from the multiplier, and these give the desired components of the Fourier coefficient of interest. This last system is given in Fig. 2. The input signal is impressed on the semiconductor Ball effect multiplier as a current, while the device itself is in a magnetic field excited by the analyzing signal produced by the tuned circuit. The dc Hall output voltage, properly detected, gives the desired Fourier coefficients.

The Mathematics of Fourier Analysis

The justification for these procedures is based on the simple mathematics of Fourier analysis. Periodic electronic signals can be represented as a series of harmonically related sinusoids:

$$U(\omega t) = a_o + a_1 \cos \omega t + a_2 \cos 2\omega t + \cdots$$
$$\cdots + b_1 \sin \omega t + b_2 \sin 2\omega t + \cdots \qquad (1)$$

The purpose of Fourier signal analysis is the determination of the a_n's and b_n's.

Fourier analysis, in practice, must be performed by numerical or analogue procedures. To simplify measurements, engineers usually use the following form of Fourier series:

$$U(\omega t) = a_o + c_1 \cos(\omega t - \theta_1) + \cdots + c_n \cos(n\omega t - \theta_n) \qquad (2)$$

Fig. 1a: The Heterodyne wave analyzer is basically a tunable voltmeter.

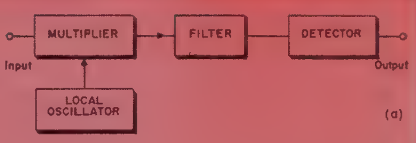


Fig. 1b: A method for complete Fourier analysis. The output from the multiplier gives rather broad peaks which are hard to identify.

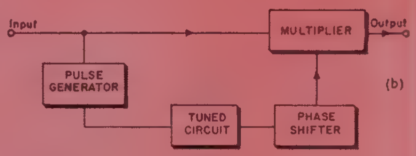
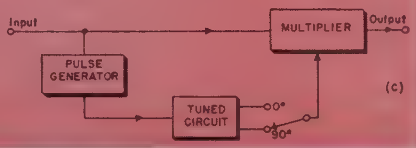


Fig. 1c: Two readings of the dc output signal from the multiplier give the desired components of the Fourier coefficient of interest.



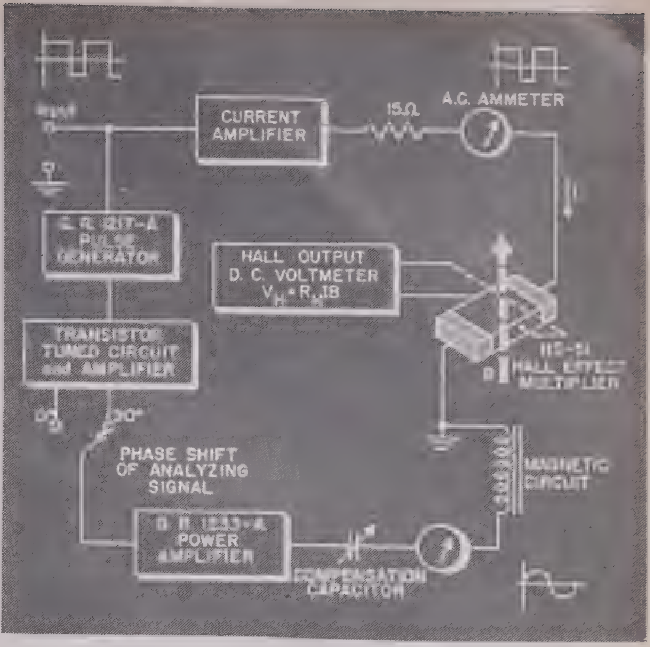

Input
CURRENT AMPLIFIER
15Ω
A.C. AMMETER
G.R. 1217-A PULSE GENERATOR
HALL OUTPUT D. C. VOLTMETER $V_H = R_H IB$
TRANSISTOR TUNED CIRCUIT and AMPLIFIER
0°
90°
PHASE SHIFT OF ANALYZING SIGNAL
HALL EFFECT MULTIPLIER
B
MAGNETIC CIRCUIT
G.R. 1233-A POWER AMPLIFIER
COMPENSATION CAPACITOR

Fig. 2: This Fournier Analysis System is the realization of the block diagram shown in Fig. 1c.

This expression is related to the representation given by Equation (1):

$$c_n = \sqrt{a_n^2 + b_n^2} \qquad (3\text{-a})$$

$$\theta_n = \tan^{-1}\left(\frac{b_n}{a_n}\right) \qquad (3\text{-b})$$

Complete Fourier representation of electronic signals is impossible with the information obtained by commercial wave analyzers. They can only detect the total magnitudes and not the phase angles. For symmetrical waves zero-time can be specified to make the phase angles all zero. Less ideal waves, usually found in practice, have phase angles which cannot be made zero. Therefore, much valuable information is lost. It is possible, using this system, to obtain the a_n and b_n coefficients directly.

The periodic signal, which can be represented as a sum of sinusoids, appears at the Hall multiplier as the input signal current. The analyzing signal, a single frequency sinusoid, appears as the magnetic field. These signals are multiplied together in the Hall effect device. For example, if the analyzing sinusoid is a sine-wave then the product voltage is:

$$P(\omega t) = \sum_{o,\,n}^{\infty} (a_n \cos n\omega t)(\sin p\omega t) + (b_n \sin n\omega t)(\sin p\omega t) \qquad (4)$$

Integration of $P(\omega t)$ gives a non-zero average value of $P(\omega t)$ only if the analyzing sinusoid has the same frequency as a component of the unknown periodic signal. This value will appear as a dc voltage at the Hall output terminals:

$$V_{dc} = \frac{b_p}{2} \qquad (5)$$

Similarly, if the analyzing sinusoid is a cosine-wave, then the dc Hall voltage would be:

$$V_{dc} = \frac{a_p}{2} \qquad (6)$$

Fourier Analyzer *(Concluded)*

The Fourier Analysis System

The system shown in Fig. 2 for determining Fourier coefficients of periodic signals has been built and tested. Periodic signals of almost any shape can be analyzed. The signal limitation is that the pulse generator be triggered at one specified point per cycle.

In this system, a periodic waveform simultaneously excites a current amplifier and pulse generator. Operation of the system can best be described by considering the response to a particular waveform (Fig. 3). A non-symmetrical square wave input will be used as an example. The current amplifier provides up to 500 ma RMS of input signal current to the Hall sample. This current is one of the multiplication terms which forms the Hall output voltage. The square wave input signal produces pulses on the positive going zero crossings of the square wave. This point can be specified as zero-time.

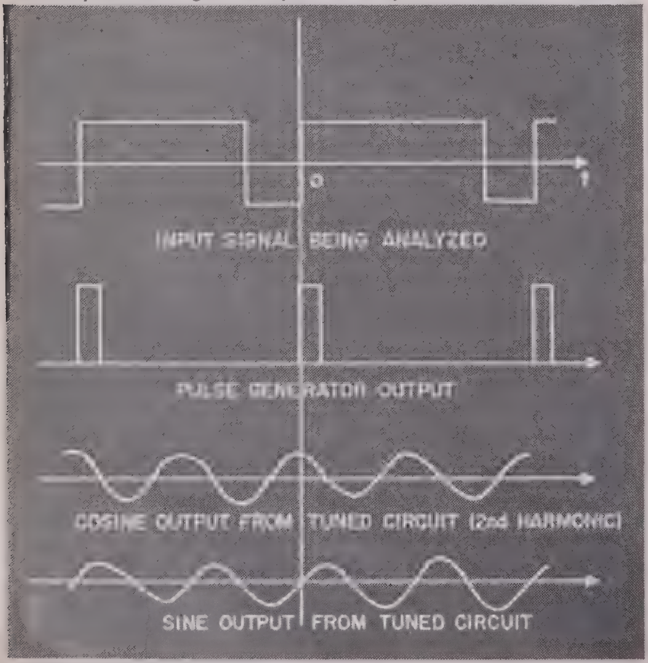
The pulses drive a variable Q transistor tuned circuit which will produce sinusoids harmonically related to the pulse repetition rate and thus to the fundamental of the input signal. Two sinusoidal output voltages are taken from the active tuned circuit. One voltage is a cosine-wave with origin coinciding with the specified zero-time on the input signal. The other output voltage is a sine-wave.

The authors are greatly indebted for the aid given willingly and frequently by Professor David J. Epstein of the MIT, and by James J. Faran, Jr., and Robert G. Fulks, engineers at the General Radio Company.

References

1. Terman, F. E., and Pettit, J. M., *Electronic Measurements*, New York, 1952, 230-288.
2. Arguimbau, L. B., "Wave Analysis," *Gen. Rad. Expt.*, 7, June, 1933, 12-14.
3. Complete Fourier coefficients are specified only if both magnitudes and phase angles are known.

Fig. 3: Operation of the system can best be described by considering the response to a particular waveform.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INPUT SIGNAL BEING ANALYZED
PULSE GENERATOR OUTPUT
COSINE OUTPUT FROM TUNED CIRCUIT (2nd HARMONIC)
SINE OUTPUT FROM TUNED CIRCUIT

By L. E. DICKENS

Johns Hopkins University
Radiation Laboratory
Baltimore, Maryland

Tunnel

THE fact that tunnel diodes have the potential for invading the realm of the so-called "low noise" devices is well known.

Many articles have been written, giving the noise figure relations of the T.D. amplifier. Hines[1] set forth the criterion for stable operation and the fundamental relations for gain. Chang[2] has reported results which have since been reproduced by many others. Van Der Ziel[3] has discussed the noise measure of the device. Tieman[4] has discussed in some detail the sources of noise, shot noise in particular, in the tunnel diode.

Equivalent Circuit:

The fundamental equivalent circuit for the tunnel diode, Fig. 1, has been shown to be well representative of the actual physical arrangement of the tunnel diode. The R_d shown in the equivalent circuit is that resistance existing across the junction for a given bias point typified by point A in Fig. 2.

R_s and L_d constitute the series parasitic impedances which accompany any physically realizable device. L_d is the lead inductance and R_s is the resistive loss of the leads and the spreading resistance of the junction itself. C_d is the junction capacity.

The circuit shown in Fig. 3 and its associated series equivalent quantities may then be used to evaluate directly the performance of a series tuned amplifier.

The values of R_s, and L_d are the same as those shown in Fig. 1. Therefore, to form the circuit of Fig. 3, only the components C_d and R_d must be transformed.

C_d and R_d are transformed by the usual Q transformations and are found to yield R'_d and C'_d, according to the following relations.

$$R'_d = \frac{R_d}{1 + Q^2_d}, \qquad (1)$$

$$C'_d = \frac{C_d\,(1 + Q^2_d)}{Q^2_d} \qquad (2)$$

$$Q_d = \omega R_d C_d \qquad (3)$$

where ω is the angular operating frequency.

The tunnel diode amplifier is examined theoretically in relation to its noise figure. A nomograph is presented which simplifies the determination of noise, with the effects of frequency on this figure.

Diode Noise Nomograph

The Amplifier Circuit:

Only the basic circuit is to be considered here. Simple reactance tuning will be assumed. Further, there is considered only the case of the amplifier using a circulator for separation of input and output signals.

If the amplifier is to be series tuned, a reactance equal to $-X$ must be placed in series with the diode as shown in Fig. 4. The circulator and the transmission lines used have characteristic impedance R_c; the source (generator) impedance is $R_g = R_c$, and the load impedance is $R_1 = R_c$.

As the square of the reflection coefficient at the diode $|\Gamma|^2$ gives the reflection power gain W_p, one finds;

$$W_p = \left|\frac{(R_s + R'_d) - R_c}{(R_s + R'_d) + R_c}\right|^2 . \tag{4}$$

Writing

$$\alpha = \frac{|R_s + R'_d|}{R_c}$$

and recognizing that to obtain gain according to Equation (4) $(R_s + R'_d)$ must be negative, W_p may be written as:

$$W_p = \left|\frac{1 + \alpha}{1 - \alpha}\right|^2 \qquad \alpha < 1 \tag{5}$$

The bandwidth may be shown to be approximately equal to:

$$B = \frac{1}{2\pi\,|R_d|\,C_d}\left(\frac{1 - \alpha}{\alpha}\right)\left(1 - \frac{R_s}{|R'_d|}\right) \tag{6}$$

Noise Figure

The article by E. G. Neilsen[5] covers the subject of noise figure in good manner. He shows the noise figure to be given as

$$F = 1 + \frac{T}{T_o}\left(\frac{\frac{G_{eq}}{G_d}R'_d + R_s}{R_c}\right) \tag{7}$$

This is the exact noise figure for the circuit shown in Fig. 3. There is an approximate expression (on the pessimistic side) which is easier to handle with information normally supplied by the manufacturer. It is noted that $|R'_d + R_s| = \alpha R_c$. Also let $T = T_o$.

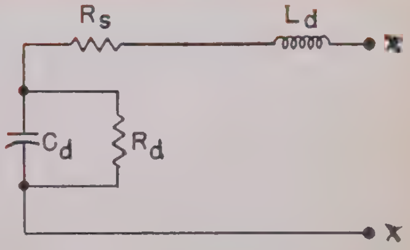

Fig. 1: Electrical equivalent circuit of the tunnel diode for a given bias point.

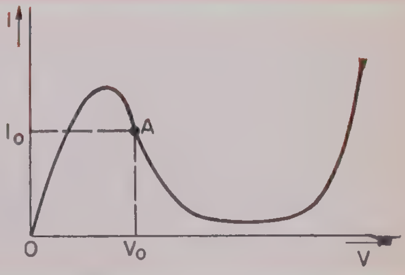

Fig. 2: Current-voltage (I-V) characteristic of a typical tunnel - diode showing bias point A in the negative resistance region.

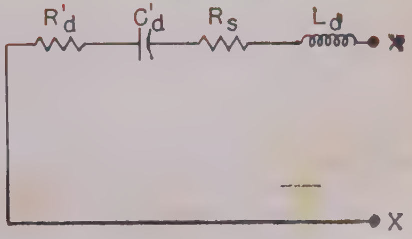

Fig. 3: Series equivalent circuit for the tunnel diode.

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Then, as shown by Neilsen[5], if the resistive cut-off frequency is that frequency for which $(R_s + R'_d) = 0$ and is given by the relation:

$$f_{co} = \frac{1}{2\pi\,|R_d|\,C_d}\sqrt{\frac{|R_d|}{R_s} - 1}\,, \qquad (8)$$

then the noise figure will take the form

$$F = \frac{1 + \frac{\alpha\, G_{eq}}{|G_d|}}{\left(1 - \frac{R_s}{|R_d|}\right)\left(1 - \frac{\omega^2}{\omega^2_{co}}\right)} \qquad (9)$$

For use as a relative measure, it is seen that $\alpha \rightarrow 1$ for very high gains leaving the noise figure relation independent of gain.

The last relation is that which allows the best insight into what affects the noise figure of the T.D. amplifier. The nomograph shown in Fig. 5 relates the three ratios

$$\frac{f}{f_{co}}, \quad \frac{R_s}{|R_d|}, \quad \frac{\alpha\, G_{eq}}{|G_d}$$

to the noise figure, in such a manner as to readily allow the determination of the noise figure, given the manufacturer's data. Conversely, as $\frac{R_s}{|R_d|}$ is normally of the order of 0.01-0.03

$$\text{and } \frac{G_{eq}}{G_d} \doteq 1,\ 1.8$$

for germanium and gallium arsenide units respectively, then the frequency cut-off of a unit to yield the desired noise figure can be obtained.

Nomograph

To use nomograph the following procedure is followed. If the noise figure for a given diode is desired at a given frequency, first determine the three ratios

$$\frac{f}{f_{co}}, \quad \frac{R_s}{|R_d|}, \text{ and } \frac{\alpha\, G_{eq}}{|G_d|}.$$

Draw a straight line connecting the point determined for

$$\frac{R_s}{|R_d|} \text{ and } \frac{G_{eq}}{|G_d|}$$

This line will intersect the pivot line (P). The intersection is the pivot point. Next draw a straight line between the pivot point and the point determined for $\frac{f}{f_{co}}$. This line will intersect the noise figure scale yielding the noise figure in decibels, as in the following example:

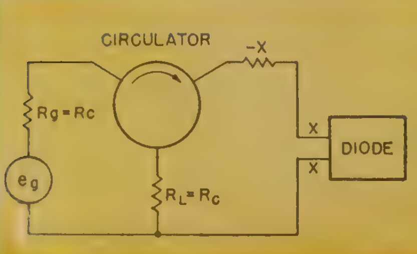

Fig. 4: Reflection type amplifier with circulator series tuned.

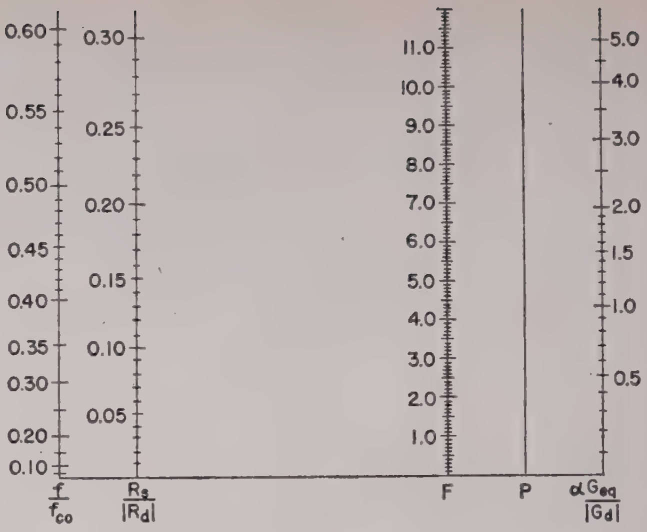

Fig. 5: Noise figure nomograph.

Suppose it is desired to find the minimum noise figure to be expected under high gain conditions $(\alpha \rightarrow 1)$ with type IN2939 germanium tunnel diode. Measured characteristics on a single unit, but not necessarily representing an average unit, yield the following data for $I_o = 0.5$ ma.

$R_s = 1$ ohm

$G_{eq} = 20\, I_o = 0.01$

$|R_d| = 111$ ohms

$f_{co} = 2.3$ kmc (Manufacturer's data)

$|G_d| = 0.009$ mhos

$I_o = 0.5$ ma was selected as being the point on the I-V curve which yields a minimum $\frac{I_o}{|G_d|}$ ratio and thus a minimum noise figure.

Accordingly

$$\frac{R_s}{|R_d|} = 0.009; \quad \frac{G_{eq}}{|G_d|} = 1.11; \quad \frac{f}{f_{co}} = 0,$$

and the noise figure as determined from the nomograph is 3.25 db.

Using the data taken from the manufacturer's sheet, the following quantities are obtained:

$I_p = 1.0$ ma

$R_s = 1$ ohm

$|G_d| = 0.01$ mhos

$f_{co} = 2.3$ kmc

The bias point for the 0.01 mho (maximum negative conductance) can be taken as approximately 0.7 I_p. Therefore, $G_{eq} = 0.014$. The ratios used are then

$$\frac{R_s}{|R_d|} = 0.01, \quad \frac{G_{eq}}{|G_d|} = 1.4, \quad \frac{}{f_{co}} = 0$$

and the noise figure as determined from the nomograph is 3.8 db. Though this value is higher than the optimized value, it is sufficiently close to allow the whole procedure to be used for quick convenient comparison and selection purposes.

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Complete Design Details for

A Transmitter Combining Network

It has been possible to feed two or three transmitters into one antenna, provided they were kept in a narrow portion of the spectrum. Here is a new method of feeding three or more transmitters, simultaneously, into one antenna, over a wide band of frequencies.

VARIOUS methods of combining several transmitters to feed a single antenna have been published. Most of these make provision for the simultaneous, or separate operation of 2 or 3 transmitters over a relatively narrow band of the frequency spectrum. Here we present a matching network, placed between the transmitter output and the antenna input terminals, which will permit simultaneous operation of three or more transmitters over a wide band of frequencies.

If the frequency range considered is two octaves or more, the impedance characteristic of the conventional antenna, e.g., a dipole or monopole, will have a large range of values. Therefore, any combining network must not only function so that there is adequate isolation between the transmitters, but also so that the network will function as a matching network.

Basically, there are two avenues of approach to the problem of matching the antenna to the transmitters. The first method is to place a complex matching network between the single output of the combining filter network and the antenna; the second is to insert the matching network between the transmitters and the combining network. Our interest is in the latter system.

In Fig. 1 the circuit of a single arm consists of n-1 trap circuits (where n is the total number of transmitters) and a two element compensating network X_{se}-X_{sh}. The terminals L L′ are the common output terminals of the transmitting arms.

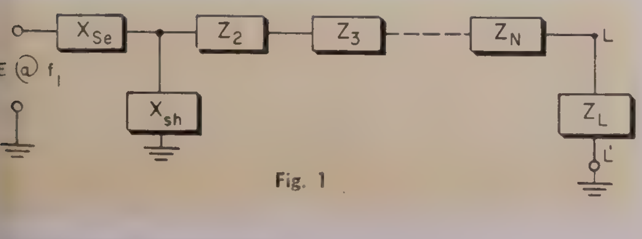

Fig. 1

As a starting point, the impedances at the appropriate frequencies will be calculated for the case where $n = 3$ followed by the general case for $n > 3$. These impedances will either act as a reactance which tends to match out the antenna, or will be such that an additional compensation will be required in the L network to match out the added reactance of the traps. As will be pointed out in some detail later, the values of C or L in the traps can be so chosen that their reactance at the passed frequency is zero, positive, or negative, depending upon the matching requirements imposed by the antenna.

Let Z_1, Z_2 and Z_3 be the impedances of the traps in arms 1, 2 and 3 at f_1, f_2 and f_3 respectively. Then

$$Z_1 = -j\left[\frac{X_{L2}\,X_{C2}}{X_{L2} - X_{C2}} + \frac{X_{L3}\,X_{C3}}{X_{L3} - X_{C3}}\right] \quad (1)$$

$$Z_2 = -j\left[\frac{X_{L1}\,X_{C1}}{X_{L1} - X_{C1}} + \frac{X_{L3}\,X_{C3}}{X_{L3} - X_{C3}}\right] \quad (2)$$

$$Z_3 = -j\left[\frac{X_{L2}\,X_{C2}}{X_{L2} - X_{C2}} + \frac{X_{L1}\,X_{C1}}{X_{L1} - X_{C1}}\right] \quad (3)$$

since

$$W_1^2 = \frac{1}{L_1\,C_1},\ W_2^2 = \frac{1}{L_2\,C_2},\ W_3^2 = \frac{1}{L_3\,C_3}$$

where W is the angular frequency, then

$$Z_1 = -j\left[\frac{W_1}{C_2\,(W_1^2 - W_2^2)} + \frac{W_1}{C_3\,(W_1^2 - W_3^2)}\right] \quad (4)$$

$$Z_2 = -j\left[\frac{W_2}{C_1\,(W_2^2 - W_1^2)} + \frac{W_2}{C_3\,(W_2^2 - W_3^2)}\right] \quad (5)$$

$$Z_3 = -j\left[\frac{W_3}{C_2\,(W_3^2 - W_2^2)} + \frac{W_3}{C_1\,(W_3^2 - W_1^2)}\right] \quad (6)$$

For $n > 3$

$$Z_1 = -j\left[\frac{W_1}{C_2\,(W_1^2 - W_2^2)} + \frac{W_1}{C_3\,(W_1^2 - W_3^2)} \cdots \right.$$
$$\left. \cdots + \frac{W_1}{C_n\,(W_1^2 - W_n^2)}\right] \quad (7)$$

$$Z_2 = -j\left[\frac{W_2}{C_1\,(W_2^2 - W_1^2)} + \frac{W_2}{C_3\,(W_2^2 - W_3^2)} \cdots \right.$$
$$\left. \cdots + \frac{W_2}{C_n\,(W_2^2 - W_n^2)}\right] \qquad (8)$$

and

$$Z_n = -j\left[\frac{W_n}{C_1\,(W_n^2 - W_1^2)} + \frac{W_n}{C_2\,(W_n^2 - W_2^2)} \cdots \right.$$
$$\left. \cdots + \frac{W_n}{C_{n-1}\,(W_n^2 - W^2_{n-1})}\right] \qquad (9)$$

It can be shown that any arm has an infinite impedance except at its design frequency.

At f_1 the impedance of the traps in branch 2 for the case of $n = 3$ is

$$Z_2 = -j\left[\frac{X_{L1}\,X_{C1}}{X_4 - X_{C1}} + \frac{X_{L3}\,X_{C3}}{X_{L3} - X_{C3}}\right]$$
$$= -j\left[\frac{W_1\,L_1/C_1 \times C_1}{W_1^2\,L_1\,C_1 - 1} + \cdots\right]$$

but

$$L_1\,C_1 = \frac{1}{W_1^2}$$

Therefore, $Z_2 = \infty$, and similarly $Z_3 = \infty$.

Therefore, any arm at its design frequency, again for the case of $n = 3$ (excluding the matching elements), appears as the circuit of the form shown in Fig. 2.

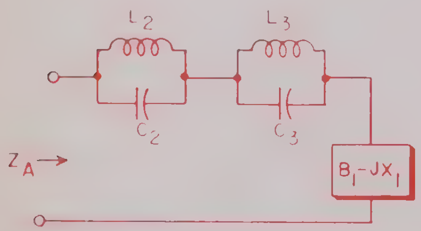

Fig. 2

In Fig.

$$Z_A = R_1 - j\left[X_1 + W_1\left(\frac{1}{C_2(W_1^2 - W_2^2)} + \frac{1}{C_3(W_1^2 - W_3^2)}\right)\right] \quad (10)$$

Where Z_A will be the impedance to be matched, and includes the trap as well as the load impedances. Setting the reactive portion equal to X_A

$$Z_A = R_1 - jXa \qquad (11)$$

and

$$Y_A = \frac{1}{R_1 - jXa} = G_A + jB_A \qquad (12)$$

or

$$Y_A = \frac{R_1}{R_1^2 + X_a^2} + j\,\frac{X_A}{R_1^2 + X_a^2} \qquad (13)$$

If we consider using an L type matching network with the shunt arm adjacent to the load, a simplified network appears as shown in Fig. 3.

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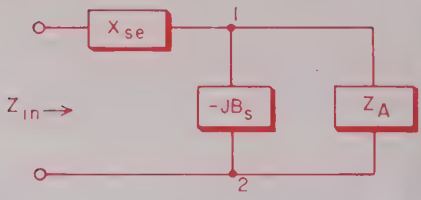
$$Y_{12} = Y_A - JB_S$$
$$= G_A - J\,(B_S - B_A)$$
$$Z_{12} = \frac{1}{G_A - J\,(B_S - B_A)}$$
$$= \frac{G_A + J\,(B_S - B_A)}{G_A^2 + (B_S - B_A)^2}$$

Fig. 3



and

$$Z_{12} = R_{12} + JX_{12} = \frac{G_A}{G_A^2 + (B_S - B_A)^2} + J\,\frac{(B_S - B_A)}{G_A^2 + (B_S - B_A)^2} \quad (14)$$

Since JX_{se} is a pure series reactance in the matching network, the value of R_{12} in the expression for Z_{12} must be equal to the value it is desired to have in the final expression for Z_{in}. In most cases a normalized value of unity will be the desired value. Hence, we have the condition that $R_{12} = 1$ or

$$\frac{G_A}{G_A^2 + (B_S - B_A)^2} = 1 \qquad (15)$$

$$\left.\begin{array}{ll} \text{Then} & B_S = \pm\sqrt{GA - GA^2} + BA \\ \text{or} & B_S = \pm\sqrt{GA\,(1 - GA)} + BA \end{array}\right\} \qquad (16)$$

By inspection $X_{12} \doteq -X$ series and

$$X \text{ series} = \mp\,\frac{(B_S - B_A)}{G_A^2 + (B_S - B_A)^2} \qquad (17)$$

The expression may be simplified by dividing (17) by (15) and

$$X \text{ series} \div 1 = X \text{ series} \div \left(\frac{G_A}{G_A^2 + (B_S - B_A)^2}\right)$$

$$\text{Then } X \text{ series} = -\,\frac{B_S - B_A}{GA}$$

but $B_S - B_A = \pm\sqrt{GA\,(1 - GA)}$ from Eq. (16)

$$\text{and } X \text{ series} = \mp\sqrt{\frac{GA\,(1 - GA)}{GA}}$$
$$= \mp\sqrt{\frac{1}{GA} - 1} \qquad (18)$$

For the case when $R_1 > 1$ by a similar manipulation

$$B_S = \pm\sqrt{GA\,(1 - GA)} - B_A \qquad (19)$$

$$\text{and } X_{12} \text{ and } X \text{ series} = \pm\sqrt{\frac{1}{GA} - 1} \qquad (20)$$

By means of the same procedure it is possible to solve for the values of the shunt and series elements when they are in juxtaposition from that of Fig. 1. If the value of X_{series} is found to be such that the shunt element will be capacitive, the capacitor may be combined with the output capacitor (assuming that type output) of the transmitter thus reducing either the number or the magnitude of the elements required.

To determine the efficiency of the system for the case of $R_1 < 1$

$$Z_{in} = \pm JX_{se} + \frac{(JX_{sh})\,(R_1 \pm JX_1)}{R_1 + J\,(X_{sh} \pm X_1)} \qquad (21)$$

where $JX_{sh} = -\dfrac{1}{JB_e}$

$$Z_{in} = \pm JX_{se} + \frac{JX_{sh}\,R_1 \mp X_1\,X_{sh}}{R_1 + J\,(X_{sh} \pm X_1)}\;\frac{[R_1 - J\,(X_{sh} \pm X_1)]}{[R_1 - J\,(X_{sh} \pm X_1)]}$$

$$= \pm JX_{se} + \frac{[J\,R_1^2\,X_{sh} \mp R_1\,X_{sh}\,X_1 + R_1\,X_{sh}\,(X_{sh} \pm X_1) \pm JX_1\,X_{sh}\,(X_{sh} \pm X_1)]}{R_1^2 + (X_{sh} \pm X_1)^2}$$

$$0 = \pm JX_{se} + \frac{J\,R_1^2\,X_{sh} \pm JX_1\,X_{sh}\,(X_{sh} \pm X_1)}{R_1^2 + (X_{sh} \pm X_1)^2}$$

since the desired input impedance is a pure resistance

$$Z_{in} = \frac{\mp R_1\,X_{sh}\,X_1 + R_1\,X_{sh}\,(X_{sh} \pm X_1)}{R_1^2 + (X_{sh} \pm X_1)^2} \qquad (22)$$

$$= \frac{\mp R_1\,X_{sh}\,X_1 \pm R_1\,X_{sh}\,X_1 + R_1\,X_{sh}^2}{R_1^2 + (X_{sh} \pm X_1)^2} \qquad (23)$$

By the condition applied on (15)

$$Z_{in} = \frac{R_1\,X_{sh}^2}{R_1^2 + (X_{sh} \pm X_1)^2} = 1 = R_{in} \qquad (24)$$

$$E = I_{in}\,R_{in} \qquad (25)$$

Normalizing E to unity then

$$I_{in} = \frac{1}{R_{in}} = \frac{R_1^2 + (X_{sh} \pm X_1)^2}{R_1\,X^2_{sh}} \qquad (26)$$

Once the value of I_{in} has been determined the real portion of the load current may be calculated and from this the real output power can be found.

Through a judicious choice of trap element components dependent upon frequency ratios the impedance of the traps may be held to a minimum so that there is a substantial increase of the combining network efficiency. To illustrate—Consider the case where $n = 3$ and for the sake of convenience

let $f_1 = 2f_2 = 4f_3$

then $W_1^2 = 4W_2^2 = 16W_3^2$

Substituting in Eq. (5)

$$Z_2 = -j\left[\frac{W_2}{C_1\,(W_2^2 - 4W_2^2)} + \frac{W_2}{C_3\left(W_2^2 - \frac{W_2^2}{4}\right)}\right]$$

$$= \frac{-j}{W_2}\left[-\frac{1}{3C_1} + \frac{4}{3C_3}\right]$$

if $C_1 = \dfrac{C_3}{4}$

Then $Z_2 = 0$

The choice, however, is limited dependent upon the practical limit for values of inductance in the traps. Other restrictive influences are the number of traps and the separation between the frequencies.

It is easy to visualize the case where R_1 is within the required tolerances of R_{in} and where the reactance of the trap circuits can be manipulated to cancel out X_1. Then, of course, the compensating elements are no longer required.

It has been shown that from an analytical approach, a combining filter and matching network may be constructed which will combine n transmitters to a single output antenna. Conversely, this same type of network could also be used for a multiple receiver system.

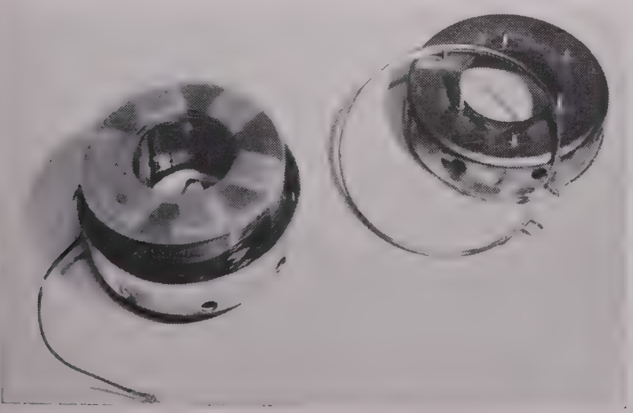
Limitations on the circuit are predicated on the power output of the transmitters and the desired isolation between the transmitters. These factors will determine the feasibility of obtaining circuit components which have realizable size and power capabilities.

Deep Drawn Mylar® Insulators

MYLAR film is now being formed or drawn into various three-dimensional shapes by Silicone Insulation, Inc., Bronx, N. Y.

An application of this technique is the drawn Mylar endcap. It is used as an insulator on the electromagnet assembly, which is a part of the R-F generating components, employed by Raytheon in their Radarange® Microwave cooking units.

Three dimensional, formed Mylar insulator endcap.



The purpose, of this endcap, is to provide insulation between the random wound coil and the coil housing, which serves as a magnetic circuit for the magnetron. To obtain the best size and cost for the electromagnet assembly, Class "B" insulation is required.

Mylar was chosen for this application because it is recognized as Class "B" and possesses high dielectric properties. Thus only a minimum thickness is required.

The three-dimensional design has the advantage of providing insulation not only at the end but also along the inside and outside diameters of the coil. The formed design also provides an easy means for the positive centering of the insulation in production.

The use of formed Mylar parts permits improvements in design where temperature resistance, dielectric strength, space saving and mechanical strength are required.

The forming of Mylar usually requires the use of matched metal molds as well as careful control of the temperature cycle. There are, of course, limits to the formability of this material. The Raytheon endcap represents a draw of only approximately one to four, but some parts have been drawn with a ratio of one to one.

No longer are designers restricted to rod, sheet, tubing, or tape when using Teflon. Now, such resin combinations are supplied in many forms. Here's how to put them to their best use by using the processor's knowledge.

Designing with Teflon

By JACK KIPNES

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MANY of the original processing problems of Teflon TFE resins have been overcome. This has permitted development of material suitable to many applications in the electronic industries.

Design Assistance

Processors can now produce material with desired properties. These properties can be altered to suit particular design requirements.

Designers must be aware of the many TFE resin forms, one or more of which may be suitable for a particular use. Sometimes, porous or high-void-content TFE is required, or, a TFE material with extremely high stress built in. Often, designers develop TFE components and do not take full advantage of its properties.

The processor, constantly conducting research in processing and fabrication, should be called upon for design assistance. They have been exposed to many of the design problems. Often, the problems can be eliminated on the drawing board without costly research.

Custom Molding

Custom molding has made great progress. Designers, working with the processor, have created many reliable components. An example of this coordination: a brass-plated rod encapsulated in Teflon, Figs. 1 & 2. The part is used in a microwave component. It was absolutely necessary that there be no void or air space between the pin and the TFE. Also, the TFE had to be free of all minute voids and cracks. Temperatures as high as 350°F were encountered during its operation. A void between the Teflon and the brass pin, at the pen's end, became evident. This caused a malfunction in the unit's operation. Calling upon one of the material's properties, a solution was obtained.

In molding, a specific amount of stress set up at the ends of the pin was incorporated into the material.

As the temperature rose during operation, the stress relaxed before the pin end became separated from the Teflon. Upon cooling, the pin caused a stress to return. Calculation showed that Teflon would expand 0.028 in. or 0.012 in. on each end of the pin.

The method of checking this stress was to slit the part through the center, remove the pin, and stress-relieve the Teflon. The cavity, created by the pin, shrank 0.028 in. or 0.014 in. on each end.

The density requirement had to be maintained at 2.150 in. to 2.158 in. because of electrical characteristics required in operating in the microwave area.

Also, the pin had to be located at the center of the part by 0.008 TIR. This specification required the use of radiography, Fig. 3. The part was machined oversized to a square. An X-ray was taken in the two planes, 90° apart. A measurement of the X-ray plates showed the exact location of the pins in respect

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to the machined surface. A special fixture offset the square so that the pin was running true during the machining operation.

TFE is also supplied in dispersion form for spraying on metal surfaces. Study of the application method and the quality of performance has yielded some extremely good results. Often, it is economical to spray a surface rather than to cement tape or sheet to make use of their properties.

Covering of critical areas will yield many advantages. Some of which are: a smooth anti-stick surface; reduced cleaning; and protection from moisture and other corrosive chemicals. Although much study has been devoted to this process, there are many diverse areas open to the use of TFE resin coatings.

Uses are being developed where large surfaces areas are electrically protected. Also, a coating of TFE will protect an electric component or assembly that is exposed to a corrosive atmosphere.

Extrusion

The extrusion process, formerly relied upon for production of rods and tubes only, is now able to supply shapes of various forms. Depending upon the requirement, a processor may use either T1 or T7 molding powder in a ram extrusion process; or, because of necessity, he may rely on T6 extrusion powder. T6 extrusion powder is blended with an aid which allows the material to flow readily through a die, forming the material to the required configuration. Depending upon design and property requirements, either the ram or flow process can be used.

These extrusion methods have been helpful in reducing component cost. A part, extruded in a "T" shape, is a good example, Fig. 4. Much less material was used when extruded compared to that used when produced from sheet. The latter would require removing excess material to form the "T" shape. With the extruded shape it was possible to rely on a die to punch the holes and square cutouts, and also cut the length to size in one operation. As an example of the monetary savings, the extruded part costs 28¢ compared to 46¢ for the machined part.

Fabrication Methods

Designers rely upon two fabricating methods — machining and molding. These two processes are related and should be considered as one. Many times a part is designed to be molded rather than machined, both for economy and property requirements. Some properties can be held more uniform by the molding of a small piece rather than by fabricating the parts from a large molded sheet.

Often even small quantities of pieces can be molded economically. The part design, coupled with the tool design, and production equipment make up the combination of factors which dictates the production of an economical component.

But sometimes it is necessary to call upon high-speed production equipment, e.g., screw machines, to fabricate a requirement. The machining method is used when control of close tolerances is necessary and where the amount of material removed is not great enough to affect the cost, Fig. 5.

Often, both machining and molding are needed to create a component. A part requiring this dual procedure was the brass pin encapsulated in a TFE, discussed earlier in this article.

Another example of this type of operation is shown in Fig. 6. This part measures 1.375 in. ±0.005 in. long by 0.875 in. ±0.005 in. wide. Over-all dimensions: 0.208 in. ±0.003 in. with a ⅛ in. radius on the 4 corners. It has a rectangular recess 1.125 in. ±0.002 in. by 0.625 in. ±0.002 in. with a depth of 0.187 in. ±0.003 in. with four ⅛ radii on the inside corners.

To save material and eliminate several machining operations the part was molded with all ±0.003 in. and ±0.005 in. tolerances to size. The ±0.002 in. tolerance, required on the rectangular recess, was machined in one operation with the use of pantograph type of milling machine.

Because of the different thicknesses in the cross section of the part, a special molding die was used. This type die is required for Teflon because it varies at a 3.5-4 to 1 ratio from fill height of the powder to pre-form. This produces a part with the required uniform

(*Continued on page* 210)

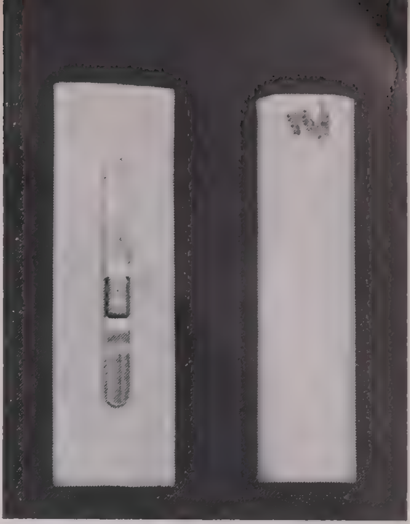


Fig. 1: Brass-plated rod successfully encapsulated in Teflon without void or air space between pin and the TFE resin.

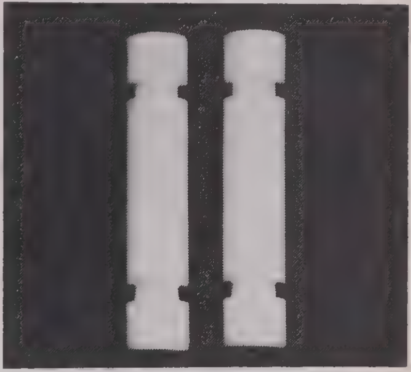


Fig. 2: Finished microwave components of Teflon are made from pieces in Fig. 1.

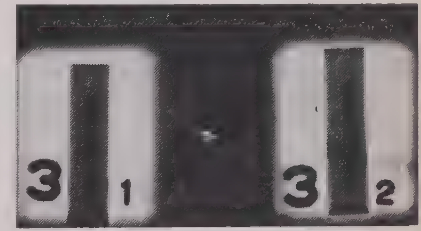


Fig. 3: Radiography was employed to aid in maintaining the center-location tolerance of the brass-plated pin.

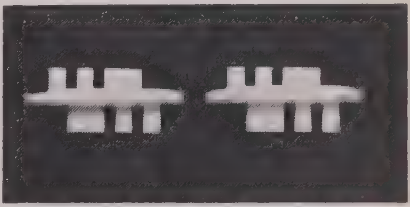


Fig. 4 (above): Extrusion lowered the cost of this shape to 28¢ from machining's 46¢.

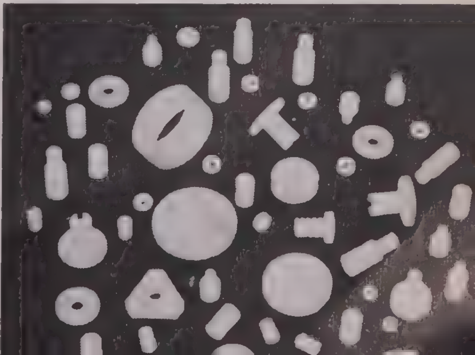


Fig. 5 (below): Machining does have its place . . . when close tolerance control is necessary and when amount of material is not appreciable.

Problems of Space Communication:

II–Sensitivity

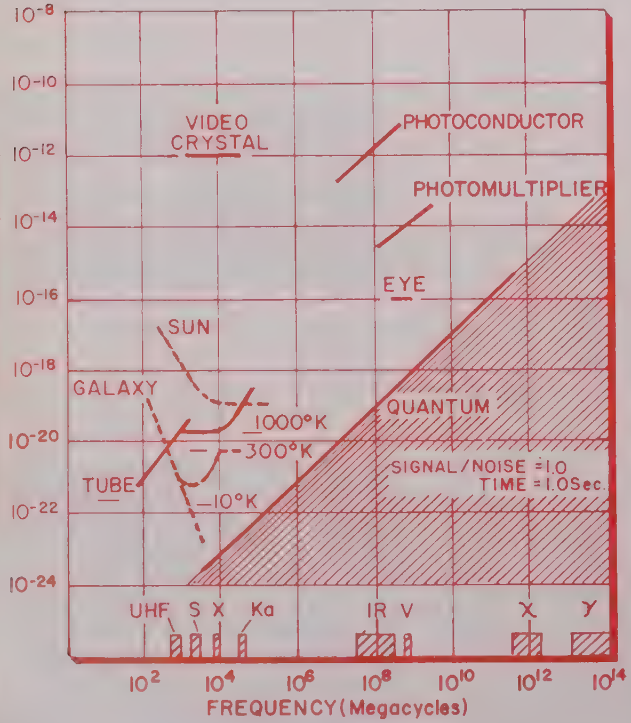
Second of a Series

IN Part 1 (April 1961, p. 116), we discussed linear receivers and introduced the definition of signal power (P_r)—that value needed at the receiver to be a certain number of times (ρ) larger than the total receiver plus antenna noise. Since this noise has a thermal spectrum, its magnitude could also be expressed in °K.

Noise Terms & Theoretical Limits

For signal radiation at much shorter wavelengths than the millimeter region, there are no linear amplifiers. The transmitted energy must be first converted or detected; then, amplified with a video or audio type receiver. The sensitivity of such receivers is the amount of radiation power (watts) at the receiver, P_r, to achieve a desired signal-to-noise ratio, ρ, in the video amplifier portion of the receiver.

Fig. 5: Sensitivity of linear and nonlinear receivers.



Linear and nonlinear receiver sensitivity can be compared only in terms of this radiation power, P_r. In complete generality the nonlinear receiver sensitivity, P_r, is expressed in MKS units, Eq. 23, where:

$h\nu$ = energy of one quantum at frequency ν

ρ = desired signal-to-noise in power ratio units

$\triangle f_e$ = video receiver bandwidth (cps) reciprocal of two times the integration or observation time

k_q = quantum efficiency of the energy converter, which is the number of electrons delivered to an electrical load per quantum of received energy. This has a maximum value of unity.

kT_o = thermal energy (joules) at the standard temperature of 290°K

F_v = the noise figure of the video amplifier (power ratio)

t_c = normalized noise temperature ratio of the energy detecting device as seen from the input of the video amplifier

ε = charge of an electron (ampere seconds)

i_D = dark current due to antenna background noise

R_L = resistance of the detector as seen from the video amplifier input.

The numerator of the term in brackets represents the noise energy due to the amplifier plus the detector; the denominator, electron energy due to the incoming radiation signal. Theoretically, for sufficiently low receiver and detector noise and/or a large enough signal level, the total value of the terms within the outside square bracket can approach a minimum value of 2. This value multiplied by the receiver video bandwidth $\triangle f_e$ represents the reciprocal of the same integration or observation time described for the linear receiver in Part 1. Since the quantum efficiency, k_q, can be unity in the limit, the minimum possible receiver power then becomes identical Eqs. (16) & (17) to that derived for the linear receiver; namely, the number of quanta, ρ, of energy, $h\nu$, received in the observation time, $\frac{1}{2}\triangle f_e$ or $1/\triangle f_c$.

For the most sensitive receivers, e.g., photomultipliers and image orthicons, the second term in the numerator of Eq. 23 is large compared to the first term, amplifier noise. Here the formula becomes Eq. 24, the standard for photocell sensitivity. The co-

Continuing with our tutorial series on energy requirements for space communications, in this article we treat nonlinear receivers. After discussing receiver noise for such devices, their sensitivity is compared with that of linear receivers.

# of Nonlinear Receivers

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Philadelphia 44, Penna.

efficient in front of the bracket is the reciprocal of the energy conversion coefficient (amps/watt) of the incident radiation. For video receivers in the microwave and millimeter region, the first term is dominant in the numerator of the bracket of Eq. (23). The expression then reduces to Eq. 25 with the substitution of *KT* as the thermal source of conduction electrons instead of $h\nu$ for the optical case. The coefficient in front of the bracket is again the reciprocal of the rectifying coefficient, expressed in amperes per watt of input radiation.

Receiver Sensitivity Comparison

The sensitivity of the best present day nonlinear receivers is shown in Fig. 5 along with values for the linear receivers mentioned in Part 1. For a common base of comparison, the bandwidth is taken to be 1 cps and a signal-to-noise ratio, ρ, of unity. (On a basis of one-second observation time, the nonlinear receiver curves should be drawn 3 db lower, i.e., one-half power P_r, than shown in Fig. 5). The sensitivity units for both the linear and nonlinear receiver is in watts on the vertical ordinate.

A lower limit is given by the line marked "quantum", Fig. 5. It represents only the terms in front of the brackets in Eqs. (16) & (23). This means that when the incoming radiation gets as low as one quantum per observation interval, the statistical rms fluctuation (noise) normalized to the average becomes unity.

The most sensitive of the nonlinear receivers is the human eye, which can detect about 100 quanta[21]. The best electronic detector is the photomultiplier tube, which is about two orders of magnitude worse. The amplifier noise in the photoconductor type receivers causes them to be less sensitive than the photomultipliers, even though the quantum efficiency, k_q, of the former is near unity compared to less than 0.2 for the latter. The video amplifier suffers both from poor video amplifier noise and poor rectification efficiency.

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The Editor
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The sensitivity of the electronic nonlinear receivers shown in Fig. 5 is for room temperature operation. The sensitivity of all can be improved by thermally cooling the detectors. Both the photomultiplier and photoconductor type detectors require the incoming radiation to have sufficient energy to liberate conducting electrons. In the present state of the art this fails for radiation wavelengths longer than about 0.8 microns (frequencies less than 4 x 10^8MC) for photomultipliers, and wavelengths longer than 15 microns (frequencies less than 0.2 x 10^8MC) for photoconductors. The video receiver obtains its conduction electrons by a thermal process, so its sensitivity has no low frequency limit.

Fig. 5 shows that the two best present-day electronic receivers, the photomultiplier in the nonlinear and the crystal and TW in the linear type, are both about 4 orders of magnitude above the quantum limitation. However, by means of masers and parametric amplifiers the linear receiver is expected to approach the quantum limitation much sooner than the nonlinear types. Furthermore, for each type receiver equally close to the quantum limit, it takes far less signal power to achieve a desired signal-to-noise ratio at microwave frequencies than in the optical range. Information is carried by the number of quanta rather than the energy in the quantum. If this were the only consideration, transmitter power would be reduced inversely as the frequency; but, this must be combined with atmosphere attenuation and antenna gain, which we will cover in later articles, to arrive at an optimum transmitter frequency.

$$P_{re} = h\nu \times \frac{\rho \, \Delta f_e}{k_q} \left[1 + \left\{ 1 + \frac{4 \, KT_o \, (F_v - 1 + t_e) + 2 \, \epsilon \, i_D \, R_L}{\epsilon^2 \, R_L \, \rho \, \Delta f_e} \right\}^{1/2} \right] \tag{23}$$

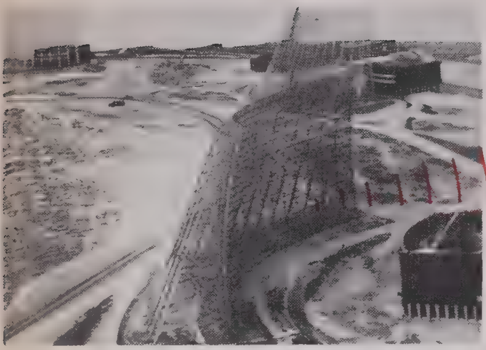
$$P_{rp} = \frac{h \, \nu}{\epsilon \, k_q} \left[2 \, \epsilon \, i_D \, \rho \, \Delta f_e \right]^{1/2} \tag{24}$$

$$P_{rv} = \frac{KT}{\epsilon \, k_v} \left[\frac{4 \, KT_o \, (F_v - 1 + t_v) \, \rho \, \Delta f_e}{R_L} \right]^{1/2} \tag{25}$$

---

[21] Rose, A. "Film, Television and the Eye," *SMPE*, Oct. 1946, pp. 273-294.

In the battle between Electronic Countermeasures (ECM) and Counter-Countermeasures (CCM) the demand for current useable information is pressing. The card file system discussed in this article works for a large corporation. It may be adapted to any other tech. data file.



Countermeasures

TO avoid wasted time and duplication of effort, Convair organized a Counter-Measures Panel comprised of personnel from their Ft. Worth (manned bombers), San Diego (manned interceptors), Astronautics (ICBM) and Pomona (surface-to-air missiles) Divs.

Among the directives in the Panel's charter were the following:

1. Obtain information on the current state-of-the-art (SOTA) and availability of techniques and components in the field of countermeasures.
2. Analyze, evaluate, and disseminate this information to the applicable corporate divisions where need-to-know was satisfactory in order to:
   a. focus constant emphasis upon the major problems in the field,
   b. recommend action to be taken to solve such problems, and
   c. appraise the adequacy of plans and projects within Convair in this area.

In order to fulfill this obligation, the Panel has developed an elaborate punch card system to enable the members to have rapid access to all counter-measures information compiled.

A human factors evaluation was made, to determine the type of information needed and the most optimum method for information retrieval. It was decided to have the information in abstract form in plain English, on a card which could be sorted and read by an individual engineer at his desk, without requiring access to either an automatic card sorting machine or microfilm reader.

The McBee Keysort® Card File System was selected, and the 7.9 x 10.5 in. card size chosen. The cards are normally kept in a classified filing cabinet or safe. When the engineer requires information, he takes the cards to his desk where he sorts them for the information. When finished he returns them to the safe.

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Organization

The system consists of two items—a "Data Card Code Directory" and a set of cards. The directory is organized into 16 divisions as follows:

I. Countermeasures Classification
  - **A. Nationality**
  - **B. Cognizant Agency**
  - **C. Type**
  - **D. Method**
  - **E. Details**
  - **F. Frequency**
  - **G. Designator**
  - **H. Security**

II. Technical Information
  - **A. Equipment Characteristics**
  - **B. Project Name**
  - **C. Techniques**
  - **D. Tactics**
  - **E. Reports**
  - **F. Personnel**

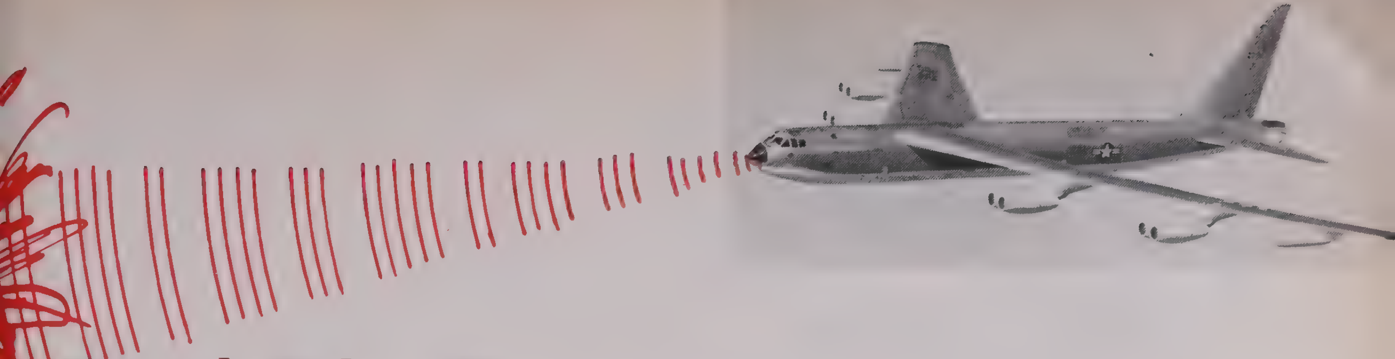
III. Production and Operational Aspects
  - **A. Contractor**
  - **B. Period of Development**

The set of cards can best be described by reference to Figure 1. As can be seen, there are six rows of concentric items around the periphery of the cards as follows:

1. Five holes per inch are punched on each of the four sides.
2. A row of numbers in sequence from 1 to 35 or 1 to 48 going from right to left along each row of holes.
3. A series of binary numbers.
4. A series of division names.
5. An alphabetical listing of the divisions.
6. The major roman numeral classifications.

In the upper central area of the card are nine blocks for item I (A through I). In the lower central area are nine blocks for other pertinent information. The middle is for a summary or abstract of the information perused by the person who made up the card, contract number, title of report, and report authors or personnel to contact for further information.

The holes are notched according to the information



Card File System

By CHESTER W. YOUNG*
Senior Research Engineer
Advanced Techniques Group
Convair/Pomona Div.
General Dynamics Corp.
Pomona, Calif.

written on the card with the exceptions: I. Countermeasure Classification—(I)—Performance Index; and the person making out the card and date. This enables the user to select the card(s) having the information he desires.

Making Up the Cards

After current written information is placed on the cards, a sequence of events leads to the notching of the holes on the edges of the cards by either a hand punch or a typewriter-like punch machine.

First the bits of information on the card are cataloged according to the 16 divisions given above. Then the individual items are referred to the data code directory to ascertain the code to be punched. The code is translated into the binary numbering system (e.g., 7 is 4 + 2 + 1). These numbers are then matched to the correct numbers in the 1 to 35 or 1 to 48 series for the particular division involved.

Using the Cards

The engineer must first consult the data card code directory for the type of information he wants and determine what the code is (e.g., AN/ALT-6). He then takes the cards from the file or safe and places them on his desk. The easiest procedure is to take a "deck" of cards 2 or 3 inches thick and stand them together on their edges so that their holes are aligned. See Figure 2. A special "needle" is inserted in the first hole of the particular code chosen. The needle is lifted and those cards notched at this particular hole will drop out. See Figure 3. The cards remaining on the needle are removed and set aside as not having the information required. The cards which have fallen off are assembled and realigned. The next hole is selected. The process is repeated for the complete code. If more than 30 cards are left, it may be advisable to select a second code having more specific information for a "finer" degree of sort unless it is desirous to scan all the cards selected.

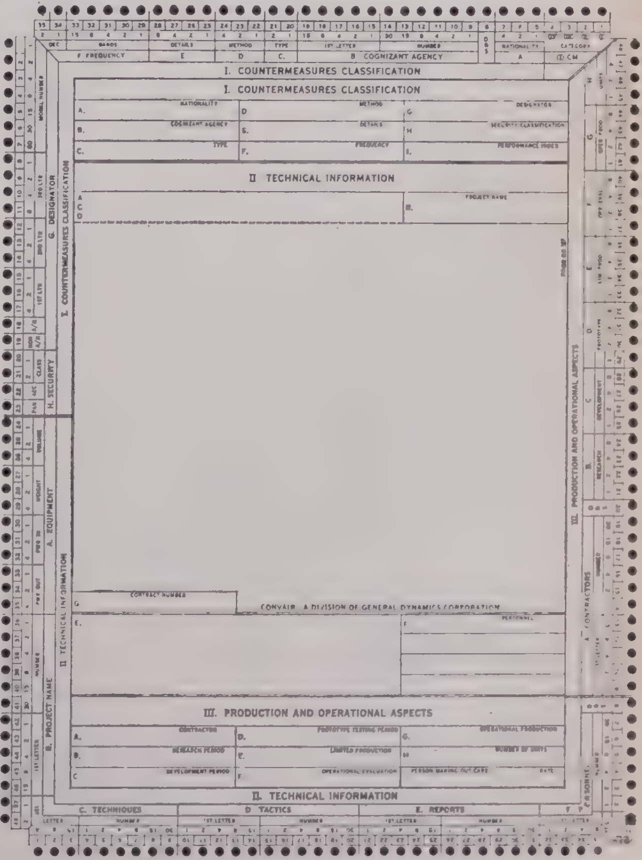
Advantages

The most appealing feature of the system is that of random access, which prevents any user from misfiling the cards after he has used them. The cards need not be put back in any particular order after using, to be ready for the next user. This has a special significance when it is realized that the system has 16 different parallel categories which would place a tremendous burden on a normal filing system.

The 16 different categories are broken down into the following numbers of codes showing the number of possible items:

(*Continued on following page*)

Fig. 1: Typical Countermeasures file card with major divisions and space for abstract of technical information.



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* Mr. Young is now a Research and Development Scientist at Walter V. Sterling, Inc., Consulting Engineers, Claremont, Calif.

Card File System *(Concluded)*

I. Countermeasures Classification
  - A. Nationality 7 different
  - B. Cognizant Agencies 1560
  - C. Type 3
  - D. Method 7 } 3x7x15=315 details
  - E. Details 15
  - F. Frequencies 30 bands
  - G. Designator (7x7x15=735 AN designators)
    - 7 first letter
    - 7 second letter
    - 15 third letter
    - 120 sequentially numbered models
  - H. Security 5 classifications

II. Technical Information
  - A. Equipment Characteristics
    - Volume 7 groupings
    - Weight 7 groupings
    - Power Input 7 groupings
    - Power Output 7 groupings
  - B. Project Names 1560
  - C. Techniques 1560
  - D. Tactics 1560
  - E. Reports 1560
  - F. Personnel 1560

III. Production and Operational Aspects
  - A. Contractors 1560
  - B thru G years 1955 to 1975 (15 groupings)

Items I(B), II(B), II(C), II(D), II(E), II(F), and III(A) use a combination "1st letter" and "number" coding. In each instance, the first letter of the identifying name is the first part of the code and an arbitrary sequential number from 1 to 60 is the second part of the code. As an example of a "Cognizant Agency," the Naval Research Laboratory (NRL) is coded 15-45 where "N" is the 15th letter of the alphabetical code ("M" is the 13th and "Mc" is the 14th) and NRL is the 45th item in the "N's." On the top edge of the card the holes 19, 14, and 13 are notched. Hole 19 is the hole for the binary number 15 and holes 14 and 13 are the holes for the binary code 45 (30 + 15).

Item I(C), "Type," has three divisions. They are "Countermeasures," "Counter-Countermeasures," and "Other or Both." Item I(D) has a breakdown of seven divisions for each of these three. For "Countermeasures" the breakdown is 1. "Deceptors-Passive-Reflectors," 2. "Deceptors-Active-Single Target Falsification," 3. "Spoofers-Multiple Target Falsification," 4. "Jammers-Obliteration," 5. "Lethal-Annihilation," 6. "Reconnaissance," and 7. "Miscellaneous." Each of these seven can be broken down into 15 details. For "Jammers" the breakdown is (1) "Spot," (2) "Barrage," (3) "Sweep," (4) "Sequential," etc. Some 105 different methods of ECM and 105 different methods of CCM can be handled by the system.

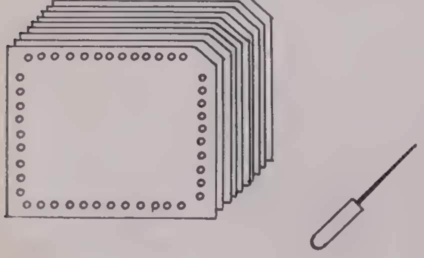


Fig. 2: "Deck" of cards and "needle". "Needle" is inserted, lifted and cards notched at that point drop out.

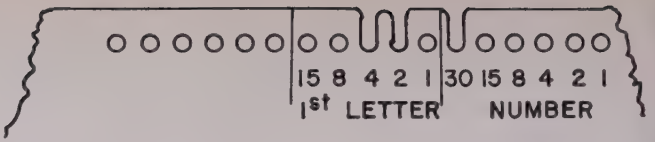


Fig. 3: Example of notched edge of a typical ECM file card.

A parallel categorization is found at the bottom of the card as item II(C) "Techniques." This enables the system to handle 1560 ECM and 1560 CCM techniques in alpha-numeric coding similar to that explained above on "Cognizant Agencies."

Item II(A), "Equipment Characteristics" breaks down the Volume, Weight, Power Input, and Power Output into seven different groupings to enable the engineer to sort for equipment which will fit into his weapon systems boundary conditions. An example of this for the "Weight" is: 1. Less than 10 lbs., 2. 10 to 99 lbs., etc.

Special "D & S" holes can be punched for personnel, contractors, and cognizant agencies indicating that these particular cards have descriptive and specialty information where applicable (e.g., contractor specializing in certain ECM aspects or component fields).

For working personnel it is highly advantageous to have material on the cards easily readable in plain English without requiring access to a microfilm reader.

A decided advantage is that information can be added to both the card and the notches with little effort.

Disadvantages

It must be admitted that the code directory is large and runs to 175 pages. However, a four page abbreviated form for "most used" codes has been made up.

In order to obtain such a large amount of sortable codes 11,150 (plus the tremendous number of combinations of them) it was necessary to go to the binary numbering system which requires multiple sorting. Single sorting would have been ideal but greatly restrictive.

Likewise, the system uses a "negative sort" in which the desired cards fall off the needle so that those remaining on the needle are set aside. If care is not taken friction of the cards will prevent a notched card from falling out of the "deck." However, this system permits new notches to be added for new information whereas a "positive" sort would require patching notches to make them back into holes for new information.

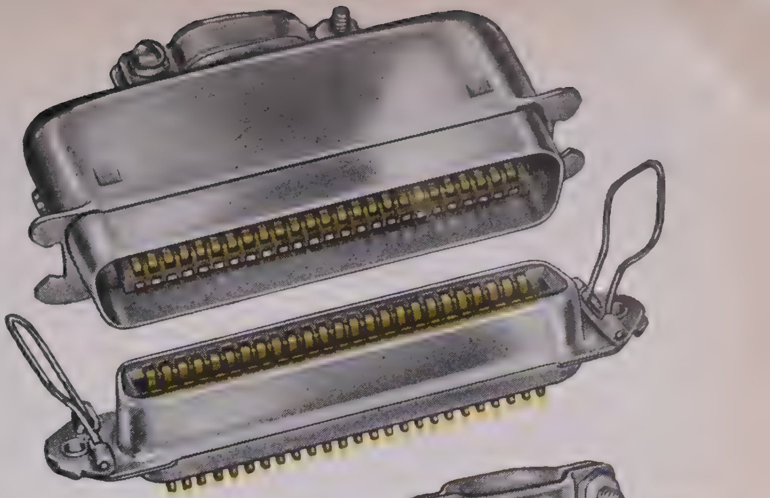
It is readily admitted that much more sophisticated use could be made of the ECM information if it were on cards usable by automatic machinery. However, these cards cannot hold the amount of plain English material without microfilm.

Conclusion

As is often said, "The proof of the pudding is in the eating," and, although this system is not ideal, it is a highly workable compromise providing a sharp tool for the working ECM engineer.

Circle 71 on Inquiry Card ⟶

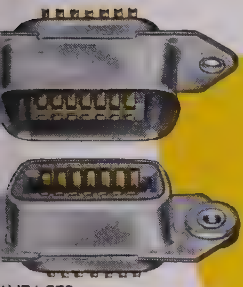
smooth, easy insertion and extraction
ion, the self-wiping, self cleaning fea-
es and the double-sided, flexing action
both mating contact members make
ro-Ribbons the first miniature connectors
provide reduction in size with added
ability.



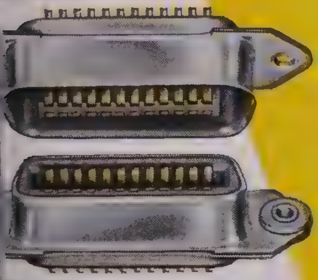
☆ CINCH

INIATURE MICRO-RIBBON ONNECTORS

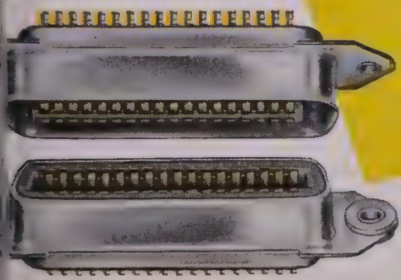
Bodies are molded of an improved Diallyl-Phthalate with extremely high impact strength and excellent dielectric features. (type MDG per MIL-M-14E) Contacts are plated .0002 silver plated plus .00003 gold. Shells are brass cadmium plated plus either clear chromate or yellow chromate per QQ-P-416 Type 2 Class 2.



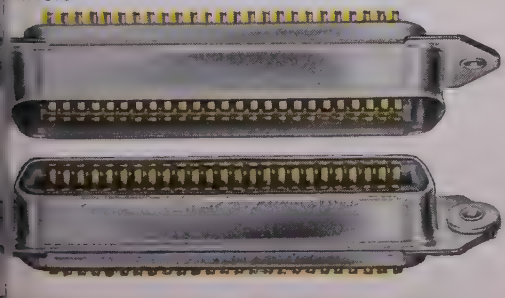
ONTACTS



NTACTS

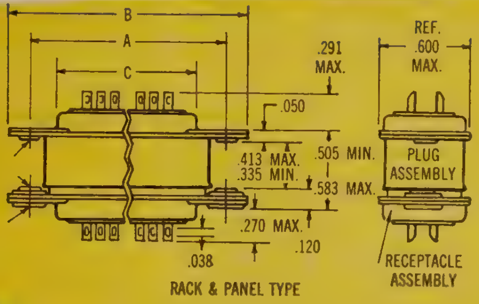


NTACTS



NTACTS

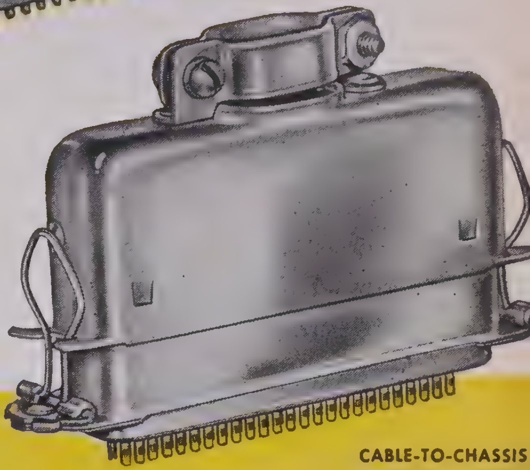
RACK AND PANEL TYPES



RACK & PANEL TYPE

DIMENSIONS

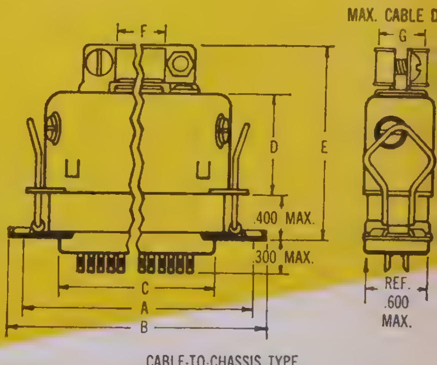
		14 Contacts	24 Contacts	36 Contacts	50 Contacts
BOTH TYPES	A	1.417	1.842	2.352	2.947
	B	1.750 REF.	2.175 REF.	2.685 REF.	3.280 REF.
	C	.910 REF.	1.335 REF.	1.845 REF.	2.440 REF.
CABLE TO CHASSIS TYPE ONLY	D	.843	.843	.905	1.000
	E	1.668 MAX.	1.668 MAX.	1.730 MAX.	1.825 MAX.
	F	.306 MAX.	.473 MAX.	.640 MAX.	.766 MAX.
	G	.422 MAX.	.473 MAX.	.473 MAX.	.473 MAX.



CABLE-TO-CHASSIS MOUNTING TYPES

The compact housings are equipped with sturdy spring type latches on the receptacles which are guided and held by cut-outs in the plug flanges.

Receptacle shells have floating bushings allowing a float of .020 in each direction.

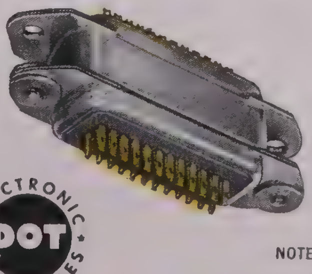


CABLE-TO-CHASSIS TYPE

Cinch ELECTRONIC COMPONENTS ®

CINCH MANUFACTURING COMPANY
1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California; St. Louis, Missouri.



ELECTRONIC DOT ASSEMBLIES

RACK AND PANEL CODE NOS.

CONTACTS	PLUG	SOCKET
14	57-10140	57-20140
24	57-10240	57-20240
36	57-10360	57-20360
50	57-10500	57-20500

CABLE-TO-CHASSIS CODE NOS.

	PLUG WITH CAP	SOCKET WITH LOCK
14	57-30140	57-40140
24	57-30240	57-40240
36	57-30360	57-40360
50	57-30500	57-40500

NOTE: Above code nos. have shells cadmium plated plus clear chromate.
For cadmium plus yellow chromate Add -1 to the nos. shown.

☆ Manufactured by agreement with Amphenol-Borg Electronics Corpora

New Tech Data for Engineers

Logic Module

Tech. Bulletin 60-F describes Type 2011 UV Logix Block One-Shot Multivibrator, a 5 MC transistorized logic circuit plug-in with 3 overlapping pulse width ranges provided by built-in timing capacitors. Rese Engineering, Inc., A and Courtland Sts., Phila. 20, Pa.

Circle 201 on Inquiry Card

AGC Amplifier

Bulletin TN 1020 diagrams and describes automatic gain control amplifiers used in resolver servo system, in a dividing servo loop, and in special function generation. Wiring schematic included. Melcor Electronics Corp., 48 Toledo St., So. Farmingdale, N. Y.

Circle 202 on Inquiry Card

Transformers

The Superior Electric Co., Bristol, Conn., has tech. data available on their Flexiformer,® a packaged transformer primary. Flexiformer Type TP1000 is essentially a self-contained toroidal primary coil encased in durable high impact plastic. This high capacity "do it yourself" transformer can serve as a source of ac voltage, resistance soldering power supply, a current transformer, or a line corrector.

Circle 203 on Inquiry Card

Subcarrier Oscillator

Dorsett Electronics, Inc., 119 W. Boyd St., Norman, Okla., has tech. information available on their Model 0-20 Transistorized Subcarrier Oscillator. The Dorsett 0-20 silicon-transistor, subcarrier oscillator is designed for FM telemetering systems and is available in all standard IRIG channels. Temp. stability is from −55°C to +125°C.

Circle 204 on Inquiry Card

Microcircuits

Varo Inc., 2201 Walnut St., Garland, Tex., is offering a catalog on its microcircuitry devices, now available as standard circuits. Featured in the catalog is data on digital, computer, control and audio freq. circuits. Photographs, complete specs. and prices are included.

Circle 205 on Inquiry Card

Pulse Generators

Slip Ring Co. of America, Electronic Timer Div., 3612 W. Jefferson Blvd., Los Angeles 16, Calif., has tech. information available on their electronic timing devices which includes time delay relays, electronic timers, pulse generators, and flashers.

Circle 206 on Inquiry Card

Clamps

A brochure which describes and illustrates mechanical and air operated clamps for holding masks and parts, and standard and special fixtures used to speed up production in high quality color decoration of mass produced products is available from Conforming Matrix Corp., 839 New York Ave., Toledo 11, Ohio. Request Form No. 7624.

Circle 207 on Inquiry Card

FM Stereo

The Electronic Industries Assoc., 1721 De Sales St., N.W., Washington 6, D. C., has available a booklet entitled, "A New World of Broadcast Sound—The Facts about FM Stereo Reception." The booklet was prepared under the sponsorship of the EIA Consumer Products Div. as part of a program to minimize possible confusion about FM stereo among dealers, broadcasters, and listeners.

Circle 208 on Inquiry Card

Trimmer Capacitors

JFD Electronics Corp., 6101 16th Ave., Bklyn. 4, N. Y., has a 24-page catalog, C-61, covering its entire line of variable trimmer piston capacitors. The booklet covers complete electrical and physical data of JFD standard, split bushing, miniature, MAX-C, sealcap, split stator and differential trimmers in panel mount and printed circuit types.

Circle 209 on Inquiry Card

Induction Heating

Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N. J., has available Tung-Sol Tips No. 18 which discusses induction heating. Illustrations, photographs and a troubleshooting chart are included.

Circle 210 on Inquiry Card

Cathode Ray Tubes

Industrial and Government Div., Continental Electronics Corp. of Calif., 2724 Leonis Blvd., Los Angeles 58, Calif., has available a completely revised condensed catalog of its industrial cathode ray tubes.

Circle 211 on Inquiry Card

Spectrum Analyzers

Varian Assoc., 611 Hansen Way, Palo Alto, Calif., is offering a catalog covering its line of Nuclear Magnetic Resonance and Electron Paramagnetic Resonance spectrometer systems and components. The 12-page catalog is illustrated and contains a brief description of the technique of NMR and EPR spectroscopy.

Circle 212 on Inquiry Card

Frequency Standards

Tech. information is available on two new types of subminiature tuning fork freq. standards with freq. tolerances to 0.001% held under certain operating conditions. Units are designed to operate under extreme environmental conditions. Both instruments have an available freq. range of 360 CPS to 4 KC and complete freq. stabilization in 30 sec. upon application of power. Accurate Instrument Co., 2418 Alabama Ave., Houston 6, Tex.

Circle 213 on Inquiry Card

Terminal Blocks

A new line of solderless terminal blocks for communications, data processing and broadcast equipment is described and illustrated in a tech. brochure available from The Thomas & Betts Co., 36 Butler St., Elizabeth, N. J. Connecto-Blok Bulletin K2-5 describes male terminals on the boards which mate with snap-on solderless terminals.

Circle 214 on Inquiry Card

Transfer Voltmeter

Ballantine Laboratories, Inc., Boonton, N. J., has tech. information available on their Model 393 High Frequency Transfer Voltmeter. Features include voltage range, 1 to 50 v.; freq. range, 25 CPS to 30 MC, and a choice of probes.

Circle 215 on Inquiry Card

Semiconductor Materials

Alpha Metals, Inc., 56 Water St., Jersey City 4, N. J., has tech. data available on Properties of Aluminum-Indium Alloys, Gold-Silicon Alloys, and Lead-Silver Alloys. Descriptions and charts included.

Circle 216 on Inquiry Card

Resistors

The Daven Co., Livingston, N. J., has available a 17-page tech. brochure covering their precision wire wound resistors. Some of the resistors covered are encapsulated, sub-miniature axial lead types, lug types, high freq., card-type, complex networks, and information on their reliability resistor program.

Circle 217 on Inquiry Card

Coil Designs

Potcore® and toroidal coils are described in an 8-page catalog available from the Bulova Watch Co., Inc., Electronics Div., 40-01 61st St., Woodside 77, N. Y. Information needed by design engineers, typical Q vs. freq. response curves, outline drawings, and applicable Mil-specs. are included for the units, both of which are available with fixed or variable inductances and open or encapsulated construction.

Circle 218 on Inquiry Card

A CASE OF *Accuracy!*

The "COMMANDER" instruments described below have a 5-year accuracy guarantee. By using NBS or NRC reported values, total cumulative errors for a complete measurement system can be as low as ±.002%.

DAUPHINEE POTENTIOMETER TYPE 9144

ACCURACY ±.001%

A new 6-figure DC vernier potentiometer with a total measuring range of 2.101010V. *Accuracy is at least 10 x that of similar commercially available equipment.* Direct readout on 4 dials in increments of .1 μv (no slidewire). Thermal emf's less than .1 μv. Switch controlled ranges of x 1 & x .1. Contains 2 saturated standard cells in an internally thermostatted enclosure. Completely "Self-Checking." *May be used with equal facility and accuracy as a Saturated Standard Cell or Resistance Comparator — and for the calibration of .01% accurate potentiometers.*

The Type 9144 is an original design by Dr. T. M. Dauphinee of the National Research Council in Canada. All rights are protected by a United States patent application.

VOLT RATIO BOX TYPE 9700A

ACCURACY ±.005%

A volt ratio box similar to that used by the National Bureau of Standards as described by NBS Research Paper RP 1419. Self-heating and surface leakage negligible. Ranges: .15/.3/.45/.6/.75/1.5/3/4.5/6/7.5/15/30/45/60/75/150/300/450/600/750/900/1050/1200/1350/1500 V. (Type 9700 up to 750 V. only). Furnished in a thermostatted oil bath with a motor-driven impeller.

CONSTANT TEMPERATURE STANDARD CELL ENCLOSURE TYPE 9152 AND SATURATED STANDARD CELL TYPE 4305

ACCURACY ±.001%

Enclosure accommodates up to 4 cells and is air thermostatted at 30°C ± .01°C. Transistorized circuit. Operates on 110V/60 cps (Battery standby). Type 9152A holds 12 cells.

THE TYPE 5214 GALVANOMETER AMPLIFIER AND TYPE SR21 LIGHT SPOT GALVANOMETER

The amplifier operates on the differential photocell principle in conjunction with a liquid-filled primary galvanometer. The secondary galvanometer has a scale length of 120-0-120 mm and is stable and free from the effects of external vibration. Over-all sensitivity is approximately 350,000 mm/μa and 52,000 mm/μv. It is ideally suited for use with the type 9144 potentiometer.

- - - - - - - - - - - - - -

Sensitive Research "COMMANDER" Instruments are manufactured by Guildline Instruments, Ltd. (formerly Tinsley Instruments (Canada) Ltd.)

SENSITIVE RESEARCH INSTRUMENT CORPORATION

NEW ROCHELLE, N. Y.

ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

Symbol of Quality

Circle 72 on Inquiry Card

New Tech Data for Engineers

Ultrasonics

Ultrasonic Industries Inc., Ames Court, Engineers Hill, Plainview, L. I., N. Y., has tech. data available on their SONIC GUN, a device for instantaneous ultrasonic defoaming, degassing, mixing, and dispersing in pipe lines or tanks. It has no moving parts and is essentially a series of vibrant antennae composed of acoustically resonant elements which are excited at their natural resonant freq. by a free-floating air-driven piston.

Circle 219 on Inquiry Card

Signal Analyzer

Quan-Tech Laboratories, Inc., Boonton, N. J., has tech. data available on their Model 317 Amplitude-Distribution Analyzer. Features include: determines the amplitude - probability distribution of random signals, reads directly in percent of time, has a switching rate, 5 MC max., and output provided to drive counter.

Circle 220 on Inquiry Card

Pulse Transformer

The Polyphase Instrument Co., E. Fourth St., Bridgeport, Pa., has available a booklet which contains charts, tables, formulas, and instructions for selecting the proper pulse transformer for a circuit.

Circle 221 on Inquiry Card

Semiconductor Catalog

Semiconductor Div., Microwave Associates, Inc., Dept. HE, South Ave., Burlington, Mass., has available a 12-page short-form catalog describing it's complete line of microwave semiconductor products. Electrical and mechanical specs. plus outline drawings with dimensions cover varactor diodes, microwave mixer diodes, microwave r-f video detector diodes, and r-f power monitoring diodes.

Circle 222 on Inquiry Card

High-Fidelity Tubes

Bulletin ETD-2622, 12 pages, describes extent and features of GE's line of audio tubes designed specifically for hi-fi. Bulletin contains specs. on current line of 26 amplifier, preamplifier and rectifier tubes, as well as information on design feature and manufacturing processes. General Electric Receiving Tube Dept., Owensboro, Ky.

Circle 223 on Inquiry Card

Evaporation Systems

Vacuum Technology, Inc., 7933 Gloria Ave., Van Nuys, Calif., has tech. information on feedthrough collars, 1-piece baseplate collars, series 7254 feedthrough flanges, and flange mounted gauges.

Circle 224 on Inquiry Card

Servo Gear Boxes

PIC Design Corp., 477 Atlantic Ave., E. Rockaway, L. I., N. Y., has available Supplement Catalog #24, a 16-page booklet on servo gear boxes for light, medium and heavy duty. Features include, oil-less bearing units, slip clutch units, and anti-backlash units.

Circle 225 on Inquiry Card

DC Power Supplies

A revised 8-page brochure covering constant voltage dc power supplies is available from Sola Electric Co., Elk Grove Village, Ill. Information covers electrical and mechanical specs. for Sola's constant voltage dc power supplies that are stock units. Bulletin "Sola Constant Voltage DC Power Supplies" CV-235-A.

Circle 226 on Inquiry Card

Terminals

AMP Inc., Eisenhower Blvd., Harrisburg, Pa., is offering a catalog which enables users to compute precisely what terminal or splice barrel size must be used to accept any given size of solid, stranded, rectangular or square wire from #26 to 1 million CM.

Circle 227 on Inquiry Card

Delay Lines

Nytronics, Inc., 550 Springfield Ave., Berkeley Heights, N. J., has tech. data available on their Wee® Lines. Wee Lines are sectionalized delay lines. Each section is designed and manufactured to be a discreet value of delay time. The total number of sections of the delay line determines the overall delay time.

Circle 228 on Inquiry Card

Hot Gas Servo Systems

A 12-page illustrated bulletin, LMEDJ 2817, described a line of hot gas servos for missile, drone, and space vehicle flight control. Basic functions performed, characteristics, specs., and applications are given. General Electric Co., Light Military Electronics Dept., 600 Main St., Johnson City, N. Y.

Circle 229 on Inquiry Card

Potentiometers

Borg Equipment Div., Amphenol-Borg Electronics Corp., 120 So. Main St., Janesville, Wis., is offering a short form brochure providing tech. data on more than 9 Micropot® Potentiometer Series and 6 Microdial® Series. Specs. such as available models, standard resistances and tolerances, temp. ranges, power ratings, sizes, linearity tolerances and number of turns are included.

Circle 230 on Inquiry Card

Tubings and Sleevings

Irvington Div., Dept. W1-358, Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn., has available a 12-page booklet on "Irvington" brand tubings and sleevings for electrical insulation in Class A through Class H temp. applications. Information covers how to pick the right tubing or sleeving, NEMA grading, methods of applying tubing and sleeving insulations, and useful storage tips.

Circle 231 on Inquiry Card

Test Instruments

Polarad Electronics Corp., 43-20 34th St., L. I. City 1, N. Y., has available a catalog digest of microwave test instruments. Listing applications and specs. of their complete line of test equipment, the booklet features a new line of transistorized test instruments including a Spectrum Analyzer, Microwave Receiver, and Calibrated Field Intensity Receiver.

Circle 232 on Inquiry Card

Panel Meters

Helipot Div., Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif., has tech. data available on their new style 42, (4½ in. rectangular) panel meter. Sheet also lists 95 standard models of voltmeters, ammeters, milliammeters, and microammeters.

Circle 233 on Inquiry Card

Waveguide Filters

Catalog No. FP61 provides detailed electrical data, including band pass and insertion loss, on a series of standard waveguide filter designs. One section enables the design engineer to estimate filter lengths and approximate number of cavities needed to obtain the devised slope of the filter envelope. Microwave Development Laboratories, Inc., Natick, Mass.

Circle 234 on Inquiry Card

Ferrite Devices

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has available a folder describing their line of ferrite devices; broadband waveguide isolators, narrowband waveguide isolators, broadband coaxial isolators, tee circulators and a dc block to cover 2.5 to 10 GC.

Circle 235 on Inquiry Card

Rectifiers

Bulletin 101, 8 pages, describes selenium rectifiers covering ranges from microamps to kiloamps and voltages from millivolts to kilovolts. Edal Industries, Inc., 4 Short Beach Rd., East Haven, Conn.

Circle 236 on Inquiry Card

SOUNDCRAFT INSTRUMENTATION TAPE IN SPACE AND UNDERSEA WITH TIROS II* AND THE SEA DRAGON

The Tape Selected For The Video System In Tiros II! Orbiting with the Tiros Weather Satellite II, developed by RCA for the National Aeronautics and Space Administration, Soundcraft Tape is used exclusively in both narrow and wide angle video tape systems. Only ⅜ of an inch wide, this tape records longitudinally rather than across the width and is the result of over five years of research.

On The Nuclear Submarine, Sea Dragon, the first undersea magnetic video tape recorders also developed by RCA, used Soundcraft instrumentation tapes to record and store data on under-ice characteristics of icebergs and ice flows. As man probes deeper and deeper into the unknown, science continues to call on the world's most modern tape plant for reliable magnetic tapes.

Discover how Soundcraft's consistent record of accomplishment can be extended and applied to fulfill your recording needs. Write for complete literature.

*Soundcraft Instrumentation Tape is, of course, used in Tiros I, and in other vital space projects as well.

REEVES SOUNDCRAFT CORP.

Main Office: Great Pasture Road, Danbury, Connecticut
New York: 10 East 52nd St. ■ Chicago: 28 East Jackson Blvd.
Los Angeles: 342 North LaBrea ■ Toronto: 700 Weston Road

R-131

New Tech Data for Engineers

Relay Terms

A 13-page booklet, "Definitions of Relay Terms" has been published by the National Assoc. of Relay Manufacturers. This is a reprint of part 10 of the ASA publication "American Standard Definitions and Terminology for Relays" C83.16-1959. Copies of this booklet may be obtained by writing to Prof. Charles F. Cameron, School of Electrical Eng'g., Oklahoma State Univ., Stillwater, Okla.

Circle 237 on Inquiry Card

Microwave Antennas

Tech. data is available from the Technical Appliance Corp., Sherburne, N. Y. on 16 new antennas available in diameters of 4, 6, 8 and 10 ft. to cover the range of 5925 to 8500 MC. The plane polarized antennas are designed for common carrier, operation fixed, studio-transmitter link, remote pickup, and government applications.

Circle 238 on Inquiry Card

Panel Instruments

Bulletin No. 01-111 contains features, selection and uses of improved 2½ and 3½ in. matched panel instruments available in round or square Bakelite cases. Information includes dimensions, availability of shielded and unshielded types, accuracies, power consumption, and expanded scale types. Daystrom, Inc., Weston Instruments Div., Newark 12, N. J.

Circle 239 on Inquiry Card

Test Equipment

Boonton Radio Corp., Boonton, N. J., has available a 1961 catalog which describes their expanded product line and features several new instruments. Some of the instruments included: UHF Q Meter, Q comparators, r-f bridges, FM-AM signal generators and sweep signal generators. Descriptions, photographs and complete specs. and a price list are included.

Circle 240 on Inquiry Card

Transistor Amplifiers

Tech bulletin 42-1018 contains detailed specs. on four standard PEC transistor amplifier packages. The bulletin describes in detail four, 4-stage transistor amplifiers ranging in power output from 0.5 mw to 3.0 mw. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis.

Circle 241 on Inquiry Card

Pin Fasteners

Tech. data covering solid grooved pin fasteners is available from Driv-Lok Sales Corp., 777 Park Ave., Sycamore, Ill. In addition to this standard line of solid grooved pins, the data file covers studs, dowels, and high-allow shear-proof pins. Finishes, dimensions and tolerances included.

Circle 242 on Inquiry Card

Computer Systems

Tentative recommendations for controlling fire problems in the installation and operation of electronic computer systems is available from the National Fire Protection Assoc. NFPA No. 75-T, "Electronic Computer Systems," 27 pages covers fire protection features in buildings and rooms housing computer systems and recommended procedures for safeguarding both the equipment and records. Price 50¢, National Fire Protection Assoc., 60 Batterymarch St., Boston 10, Mass.

Circle 243 on Inquiry Card

Potentiometers

A 12-page catalog of wire-wound potentiometers for the O.E.M. market is available from Clarostat Mfg. Co., Inc., Dover, N. H. Fourteen different series of potentiometers plus military versions are cataloged in detail. Specs, dimensions, drawings, and photographs are included. Pots. rated from 1.5 w to 50 w, and up to 75 KΩ are detailed, including power types, variable types, compact versions and encapsulated versions.

Circle 244 on Inquiry Card

Microwave Amplifiers

Wave Particle, div. Ramage & Miller, Inc., 150 So. 2nd St., Richmond, Calif., is offering tech data on electronically swept microwave signal sources (B.W.O. & V.T.M.) microwave levelers, millimeter wave length signal sources, T.W.T. amplifiers, and universal T.W.T. power supplies.

Circle 245 on Inquiry Card

Disc Files

A 12-page catalog titled, "Modular Mass Memory," covers the Bryant Series 400 disc files, with capacities from 30 million to 720 million bits. General information and specs. are provided on the files which are available with from 1 to 24 discs. Bryant Computer Products, div. Ex-Cell-O Corp., 852 Ladd Rd., Walled Lake, Mich.

Circle 246 on Inquiry Card

DC Power Supplies

Advance Engineering Data Bulletin 5-70.1 describes a complete line of high voltage dc power supplies with outputs of 250 kv at full load ratings of 50 ma. Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill.

Circle 247 on Inquiry Card

Test Instruments

Eico Electronic Instrument Co., Inc., 33-00 Northern Blvd., L. I. City 1, N. Y., has available a 3-color, 28-page catalog covering it's line of test instruments, signal generators, meters, stereo and mono hi-fi equipment, citizens radio and ham gear.

Circle 248 on Inquiry Card

Voltage References

Semiconductor Specialists, Inc., 5706 W. North Ave., Chicago 39, Ill., is offering tech. data on a low voltage reference series for voltage clipping and limiting. This series of epoxy assemblies of silicon and germanium diodes have been selected for sharp breaking forward characteristics. Rated 1.15 v. to 3 v. with 5% and 2% tolerances, these devices have negative temp. coefficients, axial lead mounting.

Circle 249 on Inquiry Card

Invention Inventory

Boeing Associated Products, Boeing Airplane Co., Seattle 24, Wash., has a brochure listing some 29 inventions. Some units included are: 3-D function generator, PDM channel selector, auto tensioner control cable, medical instruments, strain gage balance, and metalized Teflon coating.

Circle 250 on Inquiry Card

Resistors

Bulletin B-16 from the Burlington Div., International Resistance Co., P. O. Box 887, Burlington, Iowa, describes precision film resistors. The spec. charts, dimensions, derating curves, applicable military specs. and a precision film resistor selection/comparison table describe molded evaporated metal film resistors, molded deposited carbon, evaporated metal film and deposited carbon resistors.

Circle 251 on Inquiry Card

Test Instruments

"Scientific and Test Instruments, Condensed Catalog," 48 pages from Minneapolis - Honeywell Regulation Co., Sta. M389, Wayne & Windrim Ave., Phila. 44, Pa., covers amplifiers, components, data handling systems, magnetic tape instrumentation, oscillographs, relay racks, and process transmitters. Catalog G-10b.

Circle 252 on Inquiry Card

Telemetering Systems

Bulletin GEA-7163, Frequency Telemetering—Transistorized Analog System—8 pages, describes use and applications of GE's telemetering systems and new, completely transistorized analog system. Schematics plus information on system's adaptability, flexibility and specs. are included. General Electric Co., Schenectady 5, N. Y.

Circle 253 on Inquiry Card

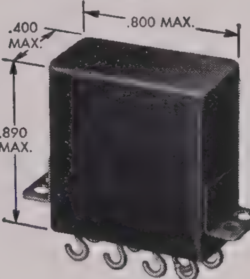
Capabilities

"This is IAS" is designed to provide, in capsule form, up-to-date information on the aims, activities and accomplishments of the Institute of the Aerospace Sciences. Copies may be obtained from the Institute of the Aerospace Sciences, 2 E. 64th St., New York 21, N. Y.

Circle 254 on Inquiry Card

ALLIED CONTROL'S

NEW Polarized Magnetic LATCHING Relay



Allied Type JP Relay
Weight: 0.6 ounces
Actual Size

The inherent vibration and shock resistance and high sensitivity of Allied's Type JP ***Permanent Magnet*** Polarized Latching Relay, combined with its ability to operate from a short pulse and remain operated without holding power, make it suitable for all phases of Aerospace applications.

Because of its latching feature and availability with single or double coils, it is also suitable as a logic or memory switching element in computers and data processing applications.

OPERATING CONDITIONS:

Vibration: 5 to 55 cps at 0.195 inch double amplitude • 55 to 2000 cps at a constant 30g

Shock: 100g operational

Sensitivity: JP (single coil) 115 milliwatt maximum transfer power • JPA-JPB (double coil) 230 milliwatt maximum transfer power

Contact Rating: Non-inductive—2 amperes at 29 volts d-c or 1 ampere at 115 volts a-c
Low level contacts are available on request

ALLIED CONTROL

ALLIED CONTROL COMPANY, INC.
2 EAST END AVENUE, NEW YORK 21, N. Y.
AL 209

Circle 74 on Inquiry Card

This is the PERFECT "Dust-free" Laboratory

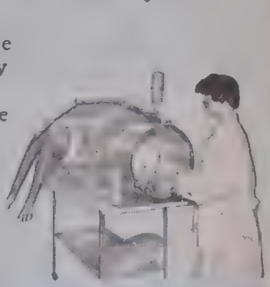
AMSCO Flexible Film Laboratory Dry Box

This low-cost, transparent "self-contained laboratory" is designed for laboratory or production procedures demanding a controlled, isolated atmosphere . . . whether it be dust-free, moisture-free, toxic compound confining, inert gas atmosphere . . . an almost endless list.

Amsco's disposable Flexible Film Dry Box is ideal for delicate transistor and diode assembly, experimental metallurgy, missile sub-assembly work, instrument assembly . . . even Alpha radiation studies. The clear plastic canopy enables technicians to work comfortably and swiftly with no eye strain.

When not in use the "envelope" may be collapsed into a compact package for convenient storage. Upon completion of certain studies, the canopy may be disposed of and replaced quickly and economically. The chamber size is 48″ long x 26″ wide x 28″ high and is provided with four "working" ports, a large interchange lock for introducing parts and several tubular ducts for service lines. Complete air filtration system is optional.

Won't this low-cost, disposable Dry Box fit into your laboratory or production plans? An Amsco man will be happy to discuss the matter in detail . . . or write for bulletin IC-607.



SCIENTIFIC AND INDUSTRIAL DEPARTMENT

World's largest designer and manufacturer of Sterilizers, Surgical Tables, Lights and related technical equipment for hospitals, industry, research

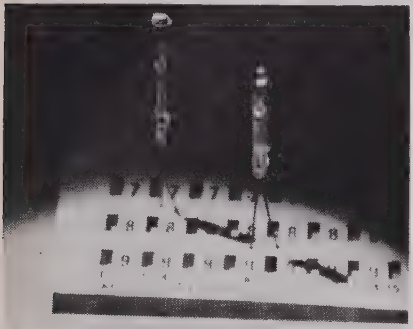
AMERICAN STERILIZER
ERIE • PENNSYLVANIA

Circle 75 on Inquiry Card

New Products . . . for the Electronic Industries

SILICON PHOTOSENSORS

Handle up to 20 v. reverse breakdown and 10 μa leakage current.

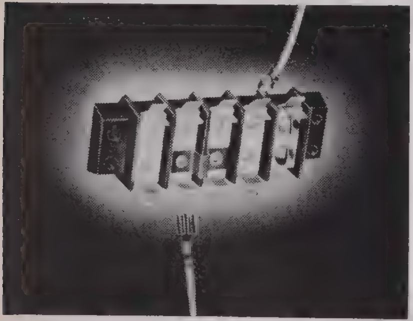


Voltage capabilities of these diodes permit the use of direct coupled circuitry eliminating the use of transformers. They are hermetically sealed in glass envelopes of 0.080 in. in dia. Spectral response covers from 5000 to 11000 angstroms. Peak response is at 9500 angstroms. Max. ratings: operating temp., −65°C to +150°C; storage temp., +175°C; reverse bias voltage for L-4412 (at 25°C), 20 vdc; reverse bias voltage for L-4413 (at 25°C), 20 vdc. Philco Corp., Lansdale Div., Lansdale, Pa.

Circle 263 on Inquiry Card

TERMINAL BLOCKS

Feature self-locking, quick disconnect wire terminations.

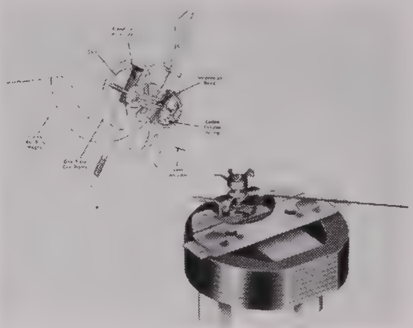


The vari-angled tabs, called "Kliptite," are designed to accept female wire terminations made by AMP, Burndy, Kent, and Arkles who supply them either singly or in rolls for automatic machine assembly. 'Kliptite' terminal blocks are for use in any application that requires a positive, yet quick-disconnect feature. 'Kliptite' terminations are also available with Kulka toggle switches and convenience outlets. Kulka Electric Corp., 633-643 So. Fulton Ave., Mt. Vernon, N. Y.

Circle 264 on Inquiry Card

SUSPENSION TYPE METER

Features resistance to extreme shock and high accuracy.



This meter makes use of a short, very thin, narrow band kept tightly suspended on special spring terminals to support the coil and its moving counter parts. There are no pivots, jewels, hairsprings, or rolling friction in this meter. Other features are special conical shaped spring anchors, providing max. resiliency for the taut suspension wire when a shock or jar reaches it from any direction. Case sizes include 2½, 3½, 4½, 6, 7 and 8 in. Triplett Electrical Instrument Co., Bluffton, Ohio.

Circle 265 on Inquiry Card

AC MAGNETIC DETECTOR

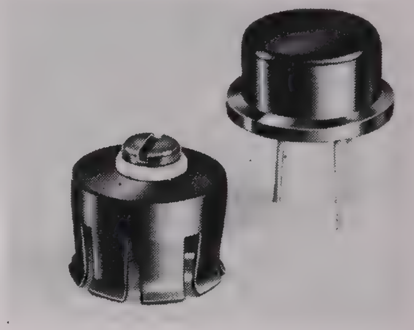
Magnetic field evaluation probe for use with an ac vtvm.

Each unit is individually calibrated in a known field, RMS voltage output is noted as a function of gauss level and is legibly printed on connector shield. Probe consists of an air core inductor, epoxy cast, within an electrostatic shield enclosure. Terminals from inductor are brought out in a pair of electrostatically shielded cables, the other end terminated with standard ¾ in. center banana plugs. Magnetic Shield Div., Perfection Mica Co., 1322 No. Elston Ave., Chicago, Ill.

Circle 266 on Inquiry Card

HEAT DISSIPATOR

Designed for use with TO-18 sized packages.



TXBP-018-028 is made entirely of beryllium copper with spring finger construction. Will fit case dia. from 0.175 to 0.190 in. Mount by pushing onto transistor and will not damage case. Suitable for printed circuit boards, chassis and heat sinks. Available in insulube or black cadmium finish. TO-18 Transistor Heat-Dissipating Retainers mount to chassis by screw-attachment. IERC Div., International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, Calif.

Circle 267 on Inquiry Card

TUNING FORK STANDARD

Miniature freq. standards for use in missile guidance systems.

It is a transistorized electro-mechanical oscillator for systems requiring a precise a-f sine wave or square wave for reference, measurements, time bases, and marker pulses. Will withstand shock of 200 G's or more. Specs: Weight, 2.9 oz.; freq., 400 to 3000 CPS; accuracy (no heater), ±0.05% (−55°C to +85°C), ±0.01% (0°C to +85°C); sine wave output, 15 v. peak to peak, load impedance 100 KΩ min. Melpar, Inc., Special Products Div., 3000 Arlington Blvd., Falls Church, Va.

Circle 268 on Inquiry Card

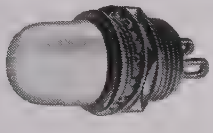
INDICATOR LIGHTS

for every panel design by

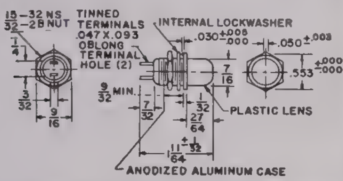
CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION
4244 West Lake Street • Chicago 24, Illinois
Telephone: Van Buren 6-3100 • TWXCG 1400

Shown below are only a few of the more than 50 basic standard types of indicator lights available from Control Switch Division. Actually, there are dozens of variations in color, mounting, appearance and circuitry possible for almost every basic style. For example, indicator lights are available for 6, 14, or 28 volt, D.C. and 110 V. A.C. circuits. So whatever your needs, there are ready-made, in-stock indicator lights to fit your panel.

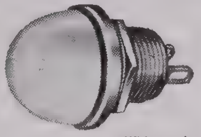
SERIES L14005B



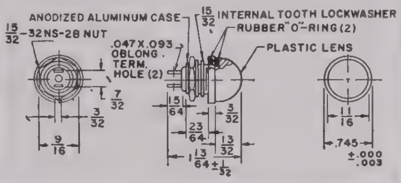
Conforms to MS-25256. Long plastic lens for 180° visibility. Front panel mounting (L14000) shown; also available for back mounting (L14200). Uses MS-25237 lamps.



SERIES L5105



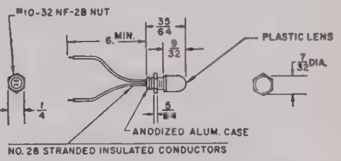
Watertight, front-of-panel mounting. Wide-angle visibility. 2-terminal circuit. Mounts in ½-inch hole. Uses MS-25237 lamps. Press-to-Test Model L16200 available.



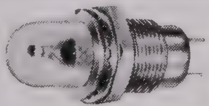
SERIES L10000

Supplied with 5V. Lamp

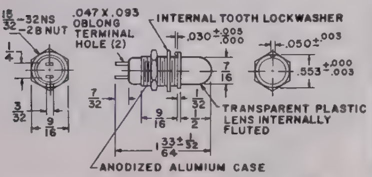
Sub-miniature, moisture-proof. Rated life of 60,000 continuous hours at 5 volts. Models available to mount flush with panel surface.



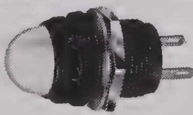
SERIES L15015B



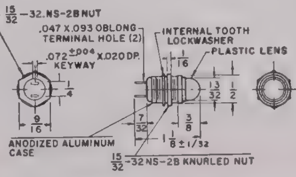
Neon indicator with built-in 62,000 ohm resistor for 115V circuits. Conforms to MS-25257. Available for front or back panel mounting.


15/32-32NS-2B NUT
.047 X .093 OBLONG TERMINAL HOLE (2)
INTERNAL TOOTH LOCKWASHER
TRANSPARENT PLASTIC LENS INTERNALLY FLUTED
ANODIZED ALUMIUM CASE

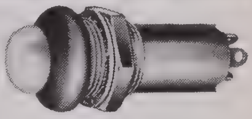
SERIES L14215



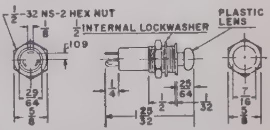
Special model for back-of-panel mounting on very compact panels. Mounting nut is tightened from front. Lens has knurled nut for easy removal of lens-lamp module. Uses MS-25237 lamps.


15/32-32NS-2B NUT
.047 X .093 OBLONG TERMINAL HOLE (2)
.072 X .020 DP. KEYWAY
INTERNAL TOOTH LOCKWASHER
PLASTIC LENS
ANODIZED ALUMINUM CASE
15/32-32NS-2B KNURLED NUT

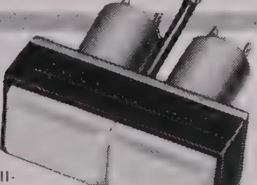
SERIES L3005



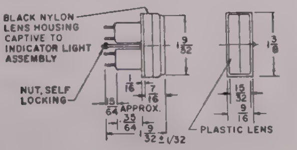
Moisture-proof push-to-test indicator light. Test lamp circuit by pushing plastic lens. Supplied with or without silicon rubber boot to seal panel. Lens has "O"-ring seal. Flange-type mounting in ½-inch hole. Uses MS-25237 lamps.



SERIES L5915

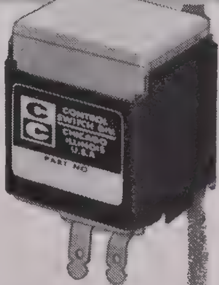


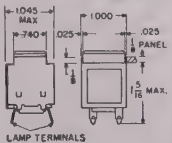
Miniature "billboard" placard contains two MS-25237 lamps. 2-color model shown (L5915), also available: 1-color (L5900) and Press-to-Test (L5200). All legends engraved (not hot-stamped). Self-indexing unit. Captive lens. L5915:


BLACK NYLON LENS HOUSING CAPTIVE TO INDICATOR LIGHT ASSEMBLY
NUT, SELF LOCKING
APPROX.
PLASTIC LENS

SERIES C6

TWINLITE modular indicator light assembly with identical panel appearance and mounting configuration to Series C6 lighted push-buttons. Mounts with barriers in rows, in matrix, or individually. Contains two lamps on individual or common circuits. Split or solid color buttons available. With 6 V. or 28 V. lamps.



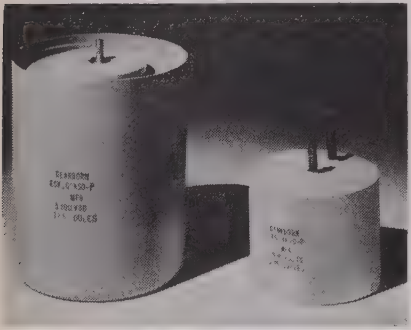


CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION
4244 West Lake Street • Chicago 24, Illinois
Telephone: Van Buren 6-3100 • TWXCG 1400

Circle 76 on Inquiry Card

STORAGE CAPACITORS

Use "cartwheel" construction techniques for high energy storage.

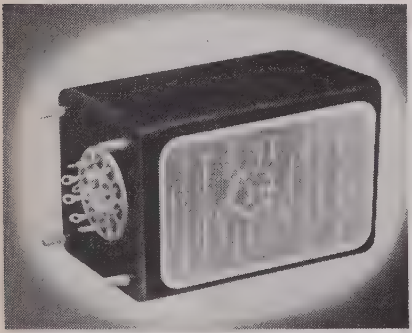


HI-PAK® Capacitors provide rapid discharge of stored energy with negligible power loss. "Cartwheel" construction minimizes self-inductance and reduces series resistance to low value. A complete discharge can be made in as little as 0.1 µsec. Uses include nuclear systems; explosive initiating circuits; low impedance pulsers; and plasma research. Available in economical polyester-wrap, resin-filled containers. Dearborn Electronic Laboratories, Inc., P. O. Box 3431, Orlando, Fla.

Circle 269 on Inquiry Card

GATING DEVICE

Hermetically sealed unit will withstand shock acceleration of 50 G.

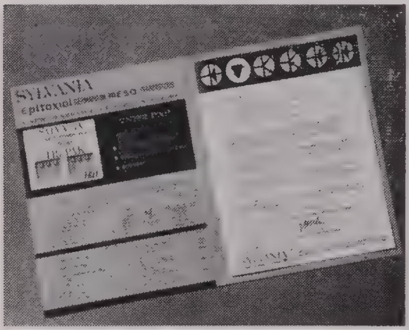


SILIGATE® operates from −65°C to +125°C, functions effectively with a single SCR in half-wave, 2 SCRs back-to-back for ac. It may be controlled by dc current, by variable resistance, or directly by transistors and also provides dc for transistor preamplification. Output is limited in voltage and current to a safe value for all SCRs of 3 a. capacity or larger, yet is capable of ample drive for 100 a. SCRs. Power consumption 1.25 w. Dresser Electronics, HST Div., 555 N. 5th St., Garland, Tex.

Circle 270 on Inquiry Card

EVALUATION KIT

Offers 6 epitaxial mesa units for the price of 3.



Called "Sylvania TRI-PAK," the kit contains 6 2N782 epitaxial mesa (pnp) transistors, 12 application circuits, and a book-style reference folder with detailed electrical and mechanical data. The Sylvania 2N782 is primarily for high speed switching applications in the nsec. range. Included with the kit are a high speed current switch, a 20 MC astable multivibrator, a 5 MC computer block source, and a 3 stage DCTL circuit. Sylvania Electric Products Inc., 100 Sylvan Rd., Woburn, Mass.

Circle 271 on Inquiry Card

MINIATURE CONNECTORS

Low cost Micro-Rac 220 and Strip 221 permit density to 175/in. sq.

Amphenol Micro-Rac is a rack and panel type connector. The Amphenol strip is for in-line, stacked and special configuration. Max. current rating in each case is 3 a., with a temp. range −65 to +250°F. Miniaturization is through the use of wire-form "poke-Home" beryllium-copper contacts, spring-tempered to resist deformation. The connectors are for use in test and communications equipment, computers and missiles. Amphenol Connector Div., Amphenol-Borg Electronics Corp., Cicero, Ill.

Circle 272 on Inquiry Card

PANEL METERS

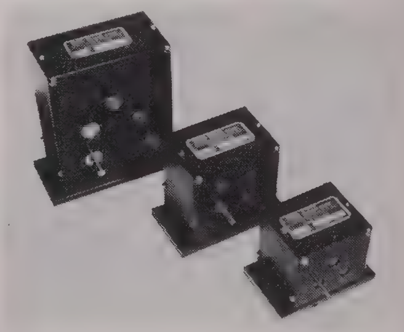
Style 42 features classically styled bezel and all-metal construction.

They are gasket sealed to keep out dirt and moisture, and steel enclosures protect the movements from effects of magnetic fields and stray r-f. These front mounting panel meters, (approx. 4.1 x 4.7 in.) use glass windows to eliminate errors due to static charges. Scale length is 3.97 in., standard accuracies are 2%. Among 95 standard models available are ammeters, milliammeters and microammeters. Helipot Div., Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

Circle 273 on Inquiry Card

SERVO GEAR BOX

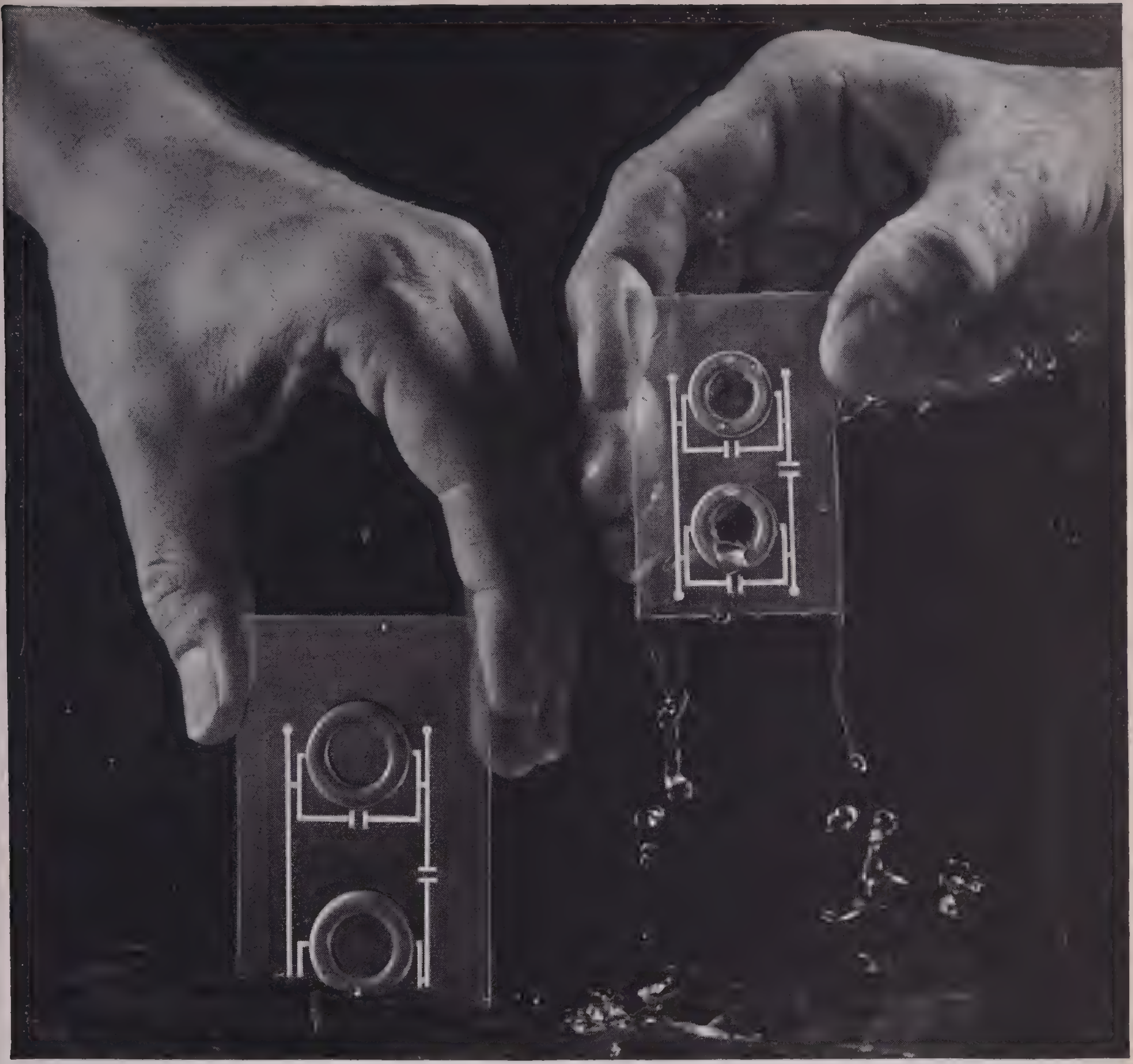
Designed for use in servo, computer and research applications.



Line of precision servo gear boxes offer over 720 variable units, providing even and exact binary ratios from 2:1 to 625:1. Backlash, measured at the output shaft with input shaft locked, held to a max. of 30′ in all models. Max. rated output torque from 250 oz. in. in the ⅛ in. shaft series, to 500 oz. in. in the ¼ in. shaft series. All units available with slip clutch, anti-backlash gears or a combination of both. PIC Design Corp., 477 Atlantic Ave., E. Rockaway, L. I., N. Y.

Circle 274 on Inquiry Card

PUTTING MAGNETICS TO WORK



How to shrink a filter!

Magnetics Inc. "120" solves the problem of core size vs. inductance in miniaturized circuits

Trying to squeeze high core inductance into a small space for use in miniaturized resonance, filter, audio, or carrier frequency circuits usually ends in a compromise. You either force more out of a smaller core, or you use a larger one. Not so, however, if you're familiar with the Magnetics Inc. "120."

This molybdenum permalloy core has a .655 inch outer diameter—is just between the .500 and the .800 inch core you may be using. What makes this little fellow unique is its inductance per 1,000 turns . . . higher than either of its neighbors, whether 60, 125 or 160 permeabilities.

Note, too, that like all Magnetics Inc. powder cores, the "120" is performance-proved and rated within realistic inductance limits. All permeabilities are available from stock now. What's more, the 125 permeability core is inductance stabilized within ±0.1% from 0° to 55°C.

More information on this and other cores in the Magnetics Inc. line is contained in design bulletin PC-203 R. It's yours by writing *Magnetics Inc., Department EI-91, Butler, Pennsylvania.*

MAGNETICS inc. ®

Circle 77 on Inquiry Card

New Products . . . for the Electronic Industries

CERAMIC CAPACITORS

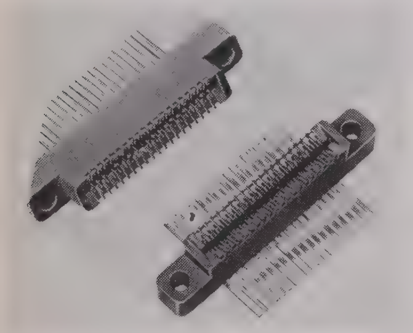
Combine advantages of vacuum dielectric and ceramic envelope.

The vacuum dielectric allows smaller units than other high voltage capacitors. It is non-puncturing, and self-healing after moderate overloads. Dielectric or corona loss is low. No plate surface contamination due to dust and moisture. Ceramic vacuum capacitors include variable capacitors up to 1000 pf and peak test voltages to 30 kv. Fixed capacitors are available up to 1225 pf and peak voltages to 45 kv. Jennings Radio Mfg. Corp., P. O. Box 1278, San Jose, Calif.

Circle 275 on Inquiry Card

SMALL CONNECTORS

Series 600-2 printed circuit connectors for micro-electronic use.



40 contacts with a 0.050 in. center-to-center spacing are mounted in a 1 11/16 in. long molding. Contacts are reliable, patented "bellowform" type, providing coil spring action grip. Recommended test voltage at sea level is 900 RMS, current rating 1 a. Illustrated are wire terminals in 2 positions: straight; and with right angle bend. Body material is glass reinforced Diallyl Phthalate per Mil-M-19833, Type GDI-30 specs. Continental Connector Corp., Woodside 77, N. Y.

Circle 276 on Inquiry Card

FLIP-FLOP

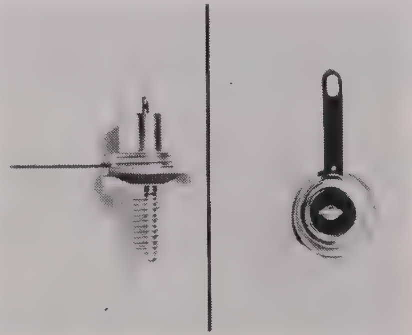
For computer circuits for satellite and missile applications.

Microminiature flip-flop consists of 12 pre-selected encapsulated components, each passivated by a silicon oxide film and mounted on a ceramic substrate measuring 0.310 x 0.310 in. The flip-flop contains the following microminiature components: 6 semiconductor resistors, 2 silicon dioxide capacitors, 2 epitaxial planar transistors and 2 fast-switching planar microdiodes. General Instrument Semiconductor Div., 65 Gouverneur St., Newark 4, N. J.

Circle 277 on Inquiry Card

POWER RECTIFIERS

"Golden Line" has reverse leakage 1 μa @ rated voltage @ room temp.

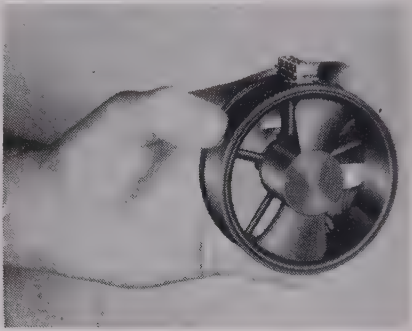


Silicon Power Rectifiers have forward voltage drop of less than 1 v. and a dynamic impedance as low as 0.0035Ω at rated current. Surge currents to 240 a. can be safely applied on the 12 a. units for 1 cycle at 60 CPS, same amperage can be obtained with the reverse polarity units. Units are said to operate at 1 KC or better. 6 and 12 amp units are available in improved "B" versions of the 1N1199-1N1206 series. Hughes Aircraft Co., Semiconductor Div., 500 Superior Ave., Newport Beach, Calif.

Circle 278 on Inquiry Card

TINY FAN

Space and weight saver in 60 CPS applications.

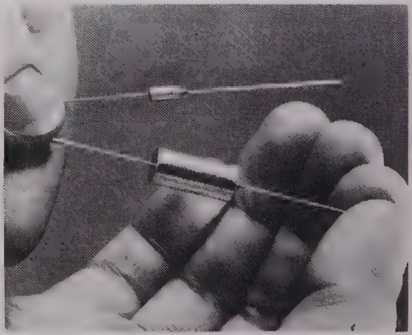


The new 60 CPS Propimax 2 measures slightly over 3 in. in dia., 1½ in. deep and weighs 6½ oz. It moves 17.5 CFM under free delivery conditions. Materials and finishes meet most applicable military specs. Power required is 0.05 a. at 115 v., under free delivery conditions. Mounting is by means of servo-ring. Impeller runs on 2 precision, double-shielded, stainless steel ball bearings. RPM at free delivery is 3250. Rotron Mfg. Co., Inc., Woodstock, N. Y.

Circle 279 on Inquiry Card

TANTALUM CAPACITORS

Types CS12 and CS13 solid tantalum units conform to Mil-C-2655A.



Ratings range from 0.033 to 330μf and from 6 to 35 wvdc. They are polar capacitors for use with a dc bias exceeding the peak value of the ac component. Operating temp. from −55°C to +125°C. Leakage currents are below Mil spec. limits. For use in airborne computer, guidance-control, and data-processing systems. Standardized into 4 miniaturized case sizes from 0.250 to 0.750 in. and in dia. from 0.125 to 0.341. Fansteel Metallurgical Corp., Rectifier-Capacitor Div., N. Chicago, Ill.

Circle 280 on Inquiry Card

NEW! Self-Check Rate of Turn Gyro Tells you "GO!" or "NO GO!"

Here is built-in reliability you can depend on. Just prior to flight, when it really counts, you can determine whether the new Honeywell Rate of Turn Gyroscope, Model JRS Series, is functioning properly by just pressing a switch . . . Green light — "GO!" . . . Red light — "NO GO!" It's just that simple. In missile applications, it can be even simpler. Manual "press-to-test" can be eliminated by programming an automatic gyro integrity check into the countdown network.

This new Honeywell Rate Gyro is designed expressly for flight control and instrumentation in missiles and aircraft where severe ambient conditions prevail . . . and at the same time where low threshold, minimum hysteresis, excellent linearity, high natural frequency, high signal-to-noise ratio, and ruggedness are essential.

Viscous damping is temperature compensated to maintain a virtually constant damping ratio over the entire operating temperature range of −65°F to +160°F.

Honeywell inertial components and engineering experience are available to assist in the solution of your gyro problems. Write for Bulletin JRS to Minneapolis-Honeywell, Boston Division, Dept. 19, 1400 Soldiers Field Road, Boston 35, Mass., or call your local Military Products Group office. Sales and Service offices in all principal cities of the world.

Honeywell

H *Military Products Group*

Honeywell Rate Gyro, Type JRS Series. Shown approx. ½ size

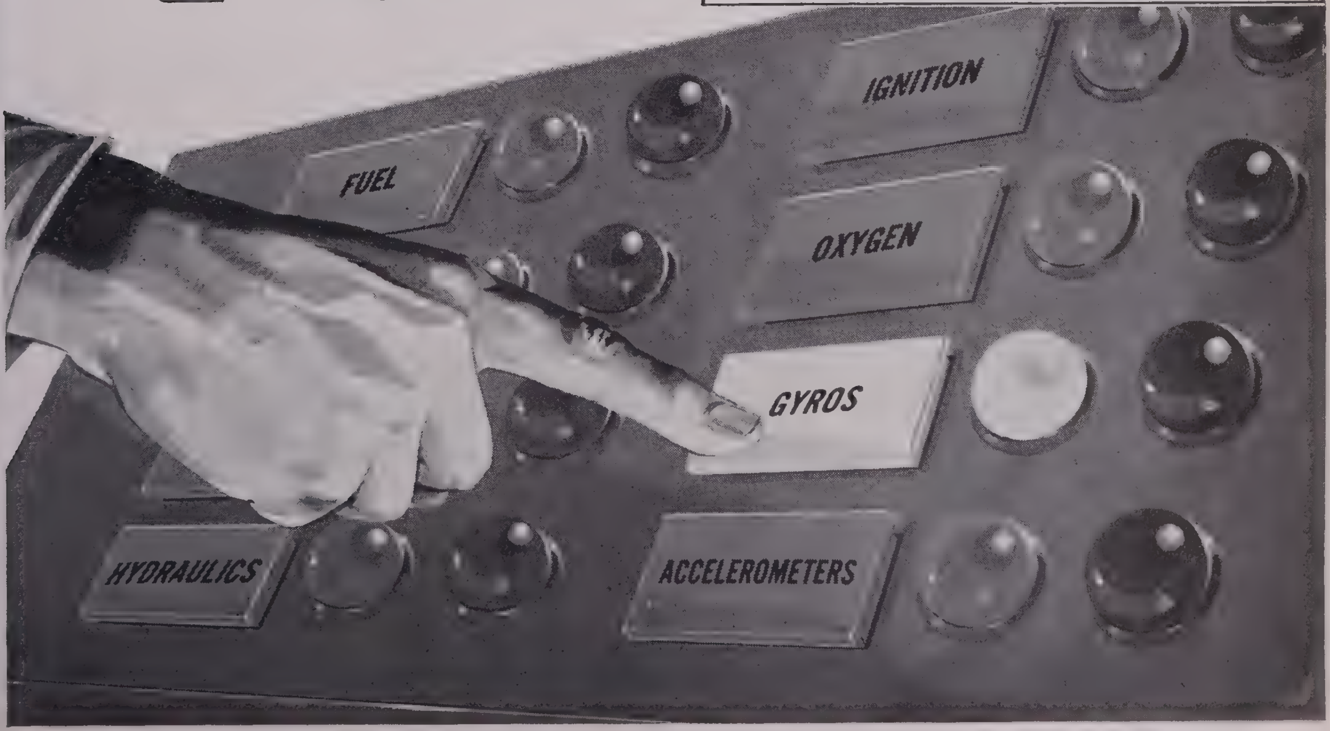
PERFORMANCE DATA

- **EXCELLENT LINEARITY:** As low as 0.25% of full scale
- **LOW HYSTERESIS:** Less than 0.1% of full scale
- **LOW THRESHOLD:** Less than 0.01 degree/second
- **MICROSYN PICKOFF:** Variable reluctance type providing infinite resolution and high signal-to-noise ratio
- **FULL SCALE RATE:** As low as 10 degree/second
- **FULL SCALE OUTPUT:** Up to 15 volts
- **RUGGED:** Withstands 100 G shock
- **VIBRATION:** Operates at 12 G to 2,000 cps
- **SIZE:** 2.11″ diam. x 4.60″ long
- **WEIGHT:** 2.2 lbs.

Consult Honeywell for your specific gyro requirements

Self-Check Feature Is Used to Determine that:

(a) Gimbal is free to rotate
(b) Restraining Spring is able to return gimbal to zero position
(c) Pickoff generates proper signal, proportionate to gimbal deflection
(d) Gimbal Deflection is proportionate to given torque exerted upon it
(e) Gyro Wheel rotates at proper speed
(f) Damping Ratio of gyro is within acceptable limits



Circle 78 on Inquiry Card

Production Stations

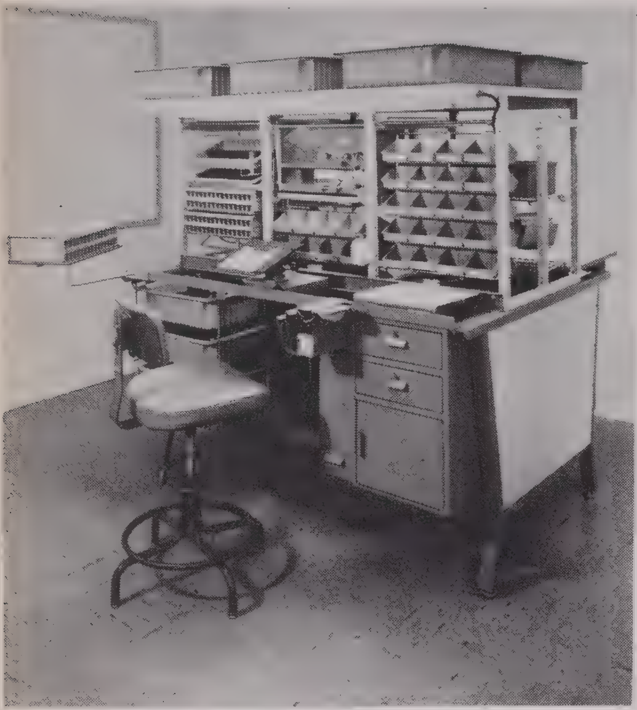


Fig. 1: Dual back to back Hughes Production Station. Also available as a single side station, separate super structure or separate work bench. A wide choice of module boxes, trays, racks, etc., is offered.

FLEXIBILITY, economy and completeness are features of Hughes Aircraft Co., Industrial Systems Div's., Production Station. This compact unit is available either back to back or single side. The super structure and work bench are also offered separately, to fit existing facilities.

Additional features are: provides shortest possible reach for parts, tools or work; designed for proper positioning of components in sequence to permit efficient assembly methods; includes revolving racks for parts cups, plus trays and larger size containers, permitting handling of a wide variety of components and sub-assemblies; has an integrated dolly and track arrangement for line flow type assembly or individual build, as desired; and is equipped with convenient power ducting.

This work station can be used not only for assembly, but also for inspection, testing, fabrication and laboratory purposes. Super structure dimensions allow installation of standard rack mount test equipment. The built in lighting gives 150-200 ft. candlepower over the entire work area.

A wide selection of wire racks, trays, module bases, power arms, holding fixtures, track lockers and other accessories are available to meet specific requirements.

More What's New on Page 138

X-Ray Crystallography Automated

RESEARCH into the atomic structure of crystals will be accelerated by a new x-ray diffraction technique. Developed by Dr. S. C. Abrahams of Bell Telephone Labs. it uses a high-speed, general purpose, digital computer to generate a control tape, which automatically operates a special type x-ray diffractometer. Data readings from the crystallographic experiment are automatically recorded on a punched tape, which is then fed back into the computer. The computer correlates the information, corrects for experimental factors, and prints out crystallographic data in a form convenient for analysis by a crystallographer.

Fig. 1: Dr. S. C. Abrahams of Bell Telephone Labs. examines a punched tape like that which will contain output data from PEXRAD, an automated x-ray diffractometer.

The new technique is called PEXRAD (Programmed Electronic X-Ray Automatic Diffractometer). Dr. Abrahams reports that with PEXRAD, it will be possible to obtain more than 17,000 readings a day. With manual methods about 3000 readings a day, and then for only 1 or 2 days at a stretch, are possible, because of strain on the crystallographer.

In the study of crystals by x-ray diffraction, a beam of x-rays is shot into a crystal. It strikes a crystal plane at a certain angle. The small scattered beams from the atoms combine into a diffracted beam that comes out of the crystal in one direction. The diffracted beam is detected by a scintillation counter. The crystal is then rotated slightly and the intensity of the diffracted beam is measured again. But this method, when done manually, is time-consuming; and it requires painstaking, routine, even tedious work.

The principles of PEXRAD are similar to an automatic neutron diffractometer method developed at Bell Laboratories in 1958.

New Bourns Precision Potentiometer Resolves the Quality-Price Dilemma!

NUMBER 18—NEW PRODUCT SERIES

Here is military reliability in a competitively-priced industrial potentiometer. Bourns wirewound 10-turn Model 3500 measures just ⅞" in diameter by 1" long—shorter by ½" than units available elsewhere—yet has a resistance element 20% longer than that of comparable potentiometers.

Fully meeting military requirements for steady-state humidity, Model 3500 can also be provided at a 10% premium to meet the cycling humidity specs of MIL-STD-202, Method 106. It's the only ⅞" 10 turn potentiometer guaranteed to meet this spec. Its published characteristics incorporate wide safety margins.

Reliability insurance is provided by the exclusive Bourns Silverweld® bond between terminal and resistance wire. Virtually indestructible under thermal or mechanical stress, this termination eliminates a chief cause of potentiometer failure. In addition, a special close-tolerance rotor almost completely does away with backlash.

Model 3500 is also subjected to the rigorous double-check of Bourns' exclusive Reliability Assurance Program. In short, every possible step is taken to ensure that the performance you specify is the performance you get. Write for complete data.

Resistances	500Ω to 125K, ± 3%, std. (to 250K spl.)
Linearity	± 0.25% std.
Power rating	2w at 70°C
Operating temp.	−65° to +125°C
Mech. life	2,000,000 shaft revolutions

INTER-OFFICE MEMORANDUM

To John Miller-Design Engineer

From Paul Hammond-Reliability Engineer

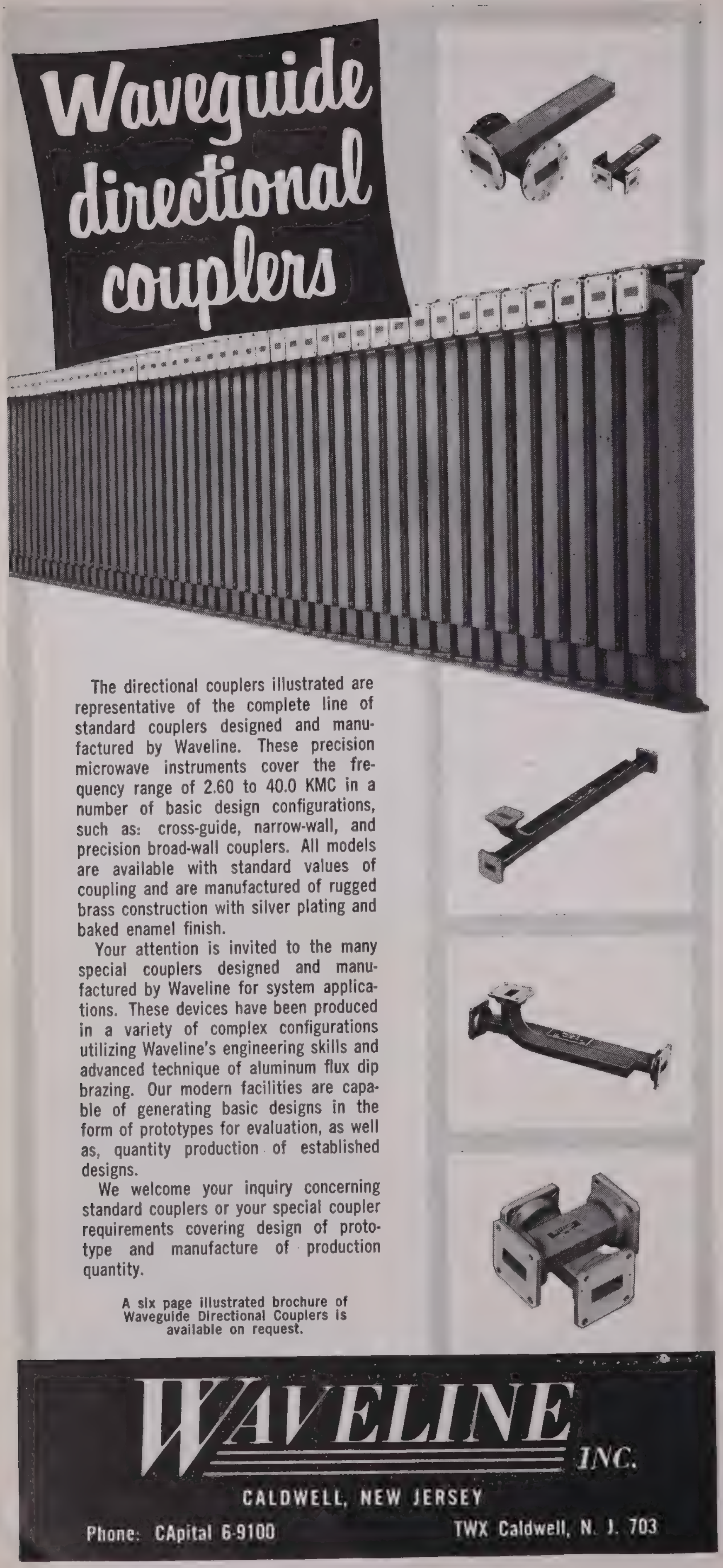
John—
you'll like
this one—
reliable +
inexpensive!
Paul

BOURNS

BOURNS, INC., TRIMPOT DIVISION
6135 MAGNOLIA AVE., RIVERSIDE, CALIF.
PHONE: OVERLAND 4-1700 · TWX: RZ 9222
CABLE: BOURNSINC

Manufacturer: Trimpot® potentiometers; transducers for position, pressure, acceleration. Plants: Riverside, California; Ames, Iowa; and Toronto, Canada

Circle 79 on Inquiry Card



Waveguide directional couplers

The directional couplers illustrated are representative of the complete line of standard couplers designed and manufactured by Waveline. These precision microwave instruments cover the frequency range of 2.60 to 40.0 KMC in a number of basic design configurations, such as: cross-guide, narrow-wall, and precision broad-wall couplers. All models are available with standard values of coupling and are manufactured of rugged brass construction with silver plating and baked enamel finish.

Your attention is invited to the many special couplers designed and manufactured by Waveline for system applications. These devices have been produced in a variety of complex configurations utilizing Waveline's engineering skills and advanced technique of aluminum flux dip brazing. Our modern facilities are capable of generating basic designs in the form of prototypes for evaluation, as well as, quantity production of established designs.

We welcome your inquiry concerning standard couplers or your special coupler requirements covering design of prototype and manufacture of production quantity.

A six page illustrated brochure of Waveguide Directional Couplers is available on request.

WAVELINE INC.
CALDWELL, NEW JERSEY
Phone: CApital 6-9100 TWX Caldwell, N. J. 703

Missile Guidance System

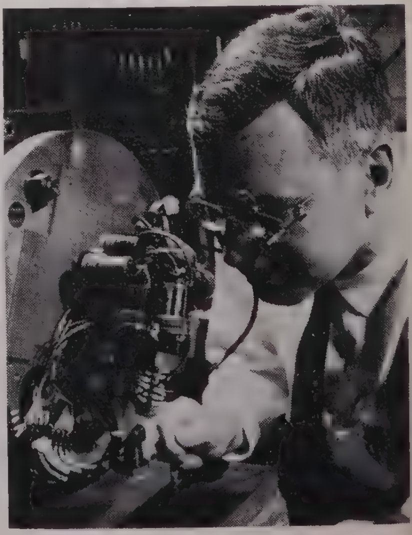
A HIGHLY accurate space guidance instrument, that can measure forces as minute as one millionth the pull of gravity from any direction, has been developed by Sperry Gyroscope Co.

Key to the operation of this inertial guidance system, is an integrated accelerometer responsible for precisely recording an unlimited range of velocity changes that may occur during flight.

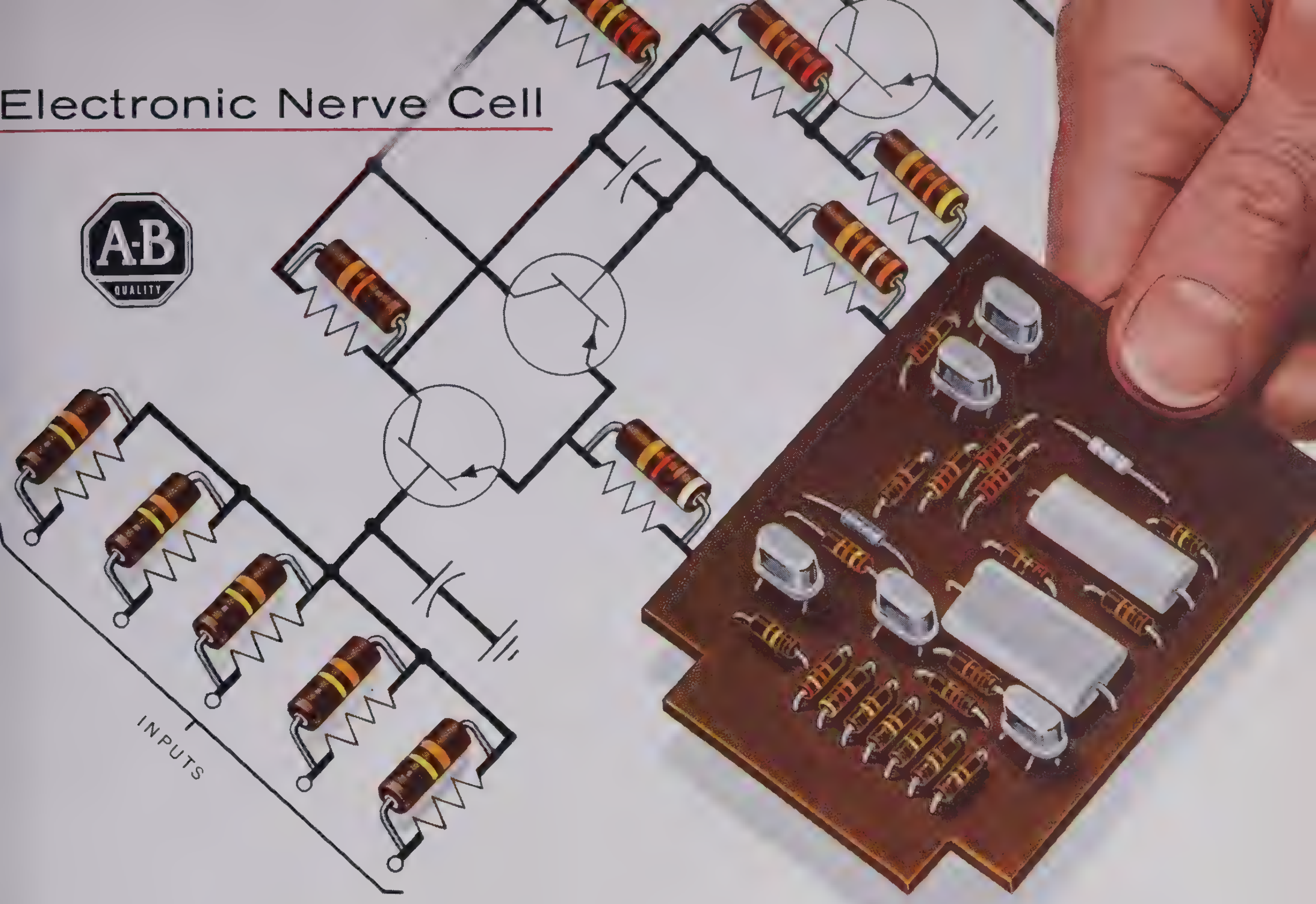
In addition to detecting minute forces, the device also can measure forces as great as 30 times the pull of gravity. Weighing slightly over 2 lbs., the compact accelerometer can replace a trio of single-direction accelerometers.

The device can also eliminate some 20 lbs. of extra equipment presently needed to integrate the information supplied by the 3 conventional accelerometers. This makes the instrument, which is the size of a man's fist, highly suitable for the compact navigation packages needed in missiles. The compact design is achieved by one lightweight frame that incorporates 3 separate accelerometer axes. Together they measure forces in the 3 dimensions of space. This feature also guarantees that the precise alignment of the 3 axes will be maintained even under the most severe stresses of launching.

Fig. 1: New device developed by Sperry Gyroscope Co. to measure a wide range of forces acting on missiles and space vehicles, is run through a series of tests by scientist at the company's Great Neck, N. Y., headquarters.



Electronic Nerve Cell



Illustrated above is a section of the schematic diagram for the artificial neuron (nerve cell).

Goal of New Research Project

MORE EFFICIENT COMMUNICATION SYSTEMS

Research to explore the information processing in nervous systems is now underway at Bell Telephone Laboratories. Here, scientists are experimenting with newly developed electronic elements which are designed to imitate the actions of a living nerve cell. Too little is yet known about living cells to permit exact electronic duplication. However, experiments with groups of artificial neurons have roughly duplicated some of the eye's basic reaction to light. This new approach to studying basic nerve network functions can provide clues for stimulating further exploration into the fundamentals of the transmission of intelligence.

Allen-Bradley is very happy that the quality of their hot molded resistors caused them to be selected for these exacting experiments. With their uniform properties and conservative ratings—A-B resistors will provide the same superior performance in your electronic circuits. Be certain you specify A-B hot molded resistors—especially for your critical jobs. Send for Publication 6024.

A-B Hot Molded Composition Resistors

SHOWN ACTUAL SIZE

Hot molded composition resistors are available in all standard EIA and MIL-R-11 resistance values and tolerances.

*Pending MIL Spec Assignment

Type TR 1/10 Watt	MIL Type RC 06*
Type CB 1/4 Watt	MIL Type RC 07
Type EB 1/2 Watt	MIL Type RC 20
Type GB 1 Watt	MIL Type RC 32
Type HB 2 Watt	MIL Type RC 42

6-61-E

ALLEN-BRADLEY **Quality Electronic Components**

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

ENLARGED VIEW OF TYPE TR RESISTOR IS 4 TIMES ACTUAL SIZE

ALLEN-BRADLEY TYPE TR RESISTORS

are STANDARD for today's miniaturized hearing aids

Because of the engineering ingenuity of the manufacturers, hearing aids have become so tiny they are hardly noticeable—since the principal objection to wearing a hearing aid has been overcome, ever increasing thousands are enjoying this remarkable contribution to the joy of hearing.

Allen-Bradley is proud to play a part in this important development. The extremely tiny Type TR fixed resistor (actually smaller than a grain of rice) is used by virtually every hearing aid manufacturer to help achieve today's amazing miniaturization—without sacrificing reliability!

Tiny as they are, these miniature resistors—made by Allen-Bradley's exclusive hot molding process—*have never experienced catastrophic failure in service*. They are remarkably "uniform" to their resistance rating. Therefore, you are only fair to yourself—and your customers—when you insist on the reliability of the A-B Type TR resistors.

For complete details, please send for Technical Bulletin 5001, and Publication 6024 which also includes information on other A-B space-saving electronic components.

SOME OF THE MANUFACTURERS OF HEARING AIDS WHO RELY ON A-B TYPE TR RESISTORS

- American Sound Products, Inc.
- Audivox, Inc.
- Beltone Hearing Aid Company
- Busse Electronics Company
- Dahlberg Company
- Dictograph Products, Inc.
- Electro Acoustic Research Labs., Ltd.
- Gem Ear Phone Co., Inc.
- Halhen Widex, Inc.
- Johnston Hearing Aid & Electronics, Inc.
- Maico Electronics, Inc.
- The Microtone Company
- E. A. Myers & Sons, Inc.
- Otarion Listener Corp.
- Qualitone Company, Inc.
- Sonotone Corp.
- Telex, Inc.
- Unex Laboratories
- Vari Electronics, Inc.

5-61-E

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QUALITY
ELECTRONIC COMPONENTS

ELECTRONIC INDUSTRIES

For Want of a . . .

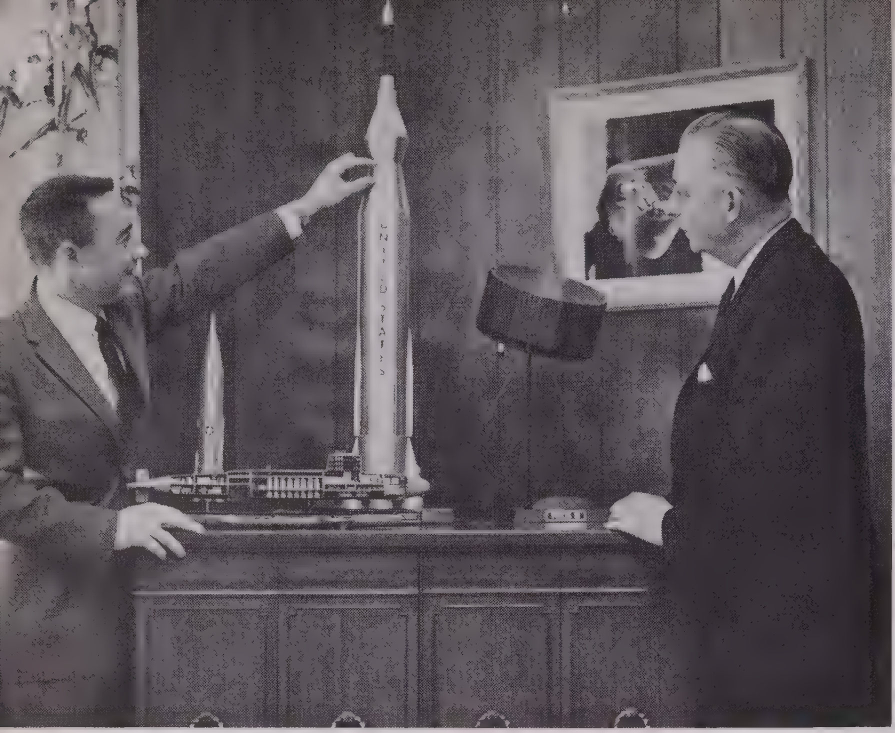
What Price RELIABILITY

By JOHN E. HICKEY, Jr.

Associate Editor

For want of a . . .
What

By JOHN E. HICKEY, JR.
Associate Editor
ELECTRONIC INDUSTRIES



IT CAN'T FAIL

Virgil I. Grissom, Astronaut, discusses facets of the Project Mercury shoot with Dr. R. Bowling Barnes, president of Barnes Engineering. Grissom represents the highest price that can be paid for poor reliability — human life.

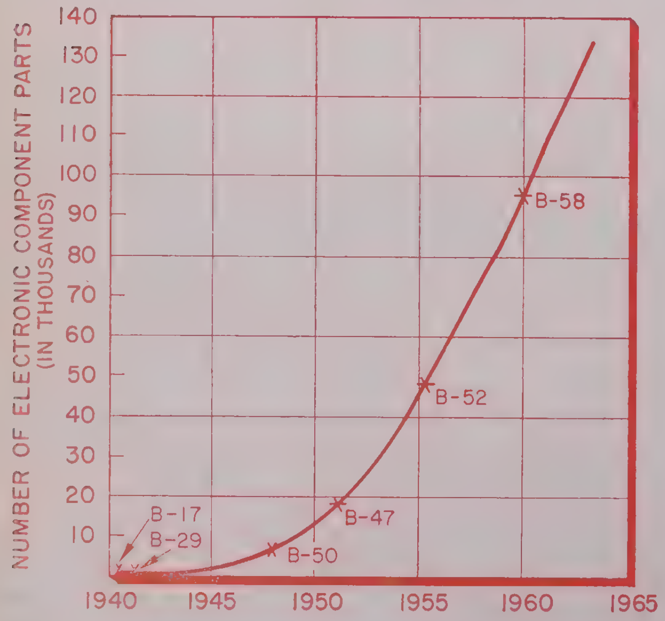
MOST of us remember the children's story that describes how "For the want of a nail a kingdom was lost." Now we find that the products of the electronics industries are in reality the nails in the kingdom of freedom.

Today electronic technology is looked to as a principal means of acquiring world leadership in offensive and defensive weaponry, and in space exploration and conquest. In our "cold war" atmosphere it is of paramount importance that all components, products and systems function "A-OK" at all times. Over the past decade there have been many efforts made on the part of military and industry alike to provide the element of reliability in electronic equipment and in electronic control systems. Many guardian technical committees have been established, articles printed, and volumes written on how to achieve and preserve this elusive quality. But in the overall nationally, we are still far below our capabilities in this connection.

COMPLEXITY INCREASES

More electronic equipment is being used in today's aircraft. This means more parts and more chances of a failure.

(Drawing courtesy of Hughes)



We must one and for all meet, understand, and conquer our reliability problems to prevent any further unnecessary loss of time, prestige, money, and perhaps even loss of life. All of us must shoulder this responsibility . . . taxpayers, members of Congress, members of the military and government procurement groups, individual manufacturers and industry as a whole!

The obligation for the procurement and production of reliable electronic equipment lies with the following three primary groups—the legislative branch of the Federal Government, the military and the individual manufacturers. Each of these groups has definite responsibilities. Overzealousness in carrying out these responsibilities on the part of one group, without careful coordination with the activities of the other two, gives rise to many of our reliability problems. These problems may be broken down roughly as follows:

Congress
- The low bid philosophy
- Reliability vs. maintenance costs
- Few of-a-kind systems
- Pushing the state-of-the-art
- Usurping patent rights
- Work in depressed areas
- Work for depressed companies

Military
- Relegated a middleman role
- Contract writing
- Contractor penalties and incentives
- Contract awarding
- Required level of reliability
- Planning and scheduling

A timely staff report providing an overall view on a most controversial subject. Are present procurement practices right or wrong? Can we push the state of the art and still maintain reliability? What future roles Congress, the military, manufacturers and individuals must play.

ELECTRONIC INDUSTRIES
STAFF REPORT

Price RELIABILITY?

Manufacturer
- Honest bidding
- Organizing for reliability
- Management's view
- Employee disciplines
- The designer's role
- Failure recurrence
- About vendors
- Inspection and testing

Now, with the above in mind, let us study the reliability procurement picture more closely.

To Our Congress . . .

The problems start with money. The largest portion of our electronic business depends now on defense spending. Congress allocates funds to the government agencies for expenditure in our industry. These agencies in turn have the responsibility of obtaining the most for each dollar spent. Thus, when the military assigns a project (spends money) to a company, the first question arising is "did the contract go to the lowest bidder?" If the contract did not go to the lowest bidder, the situation becomes subject to extensive question, investigation and justification.

The rule of the lowest bidder is excellent so long as the services or equipment to be supplied are equal in all respects. When buying reliable equipment, however, low price alone is not the answer. Carrying this low bid philosophy to extremes, as often happens, can be very detrimental. Here are some typical situations:

In some cases the low bid will force the procuring agency to award a contract even though this agency, through knowledge or past experience, feels that the contractor involved is not the right one for the assignment.

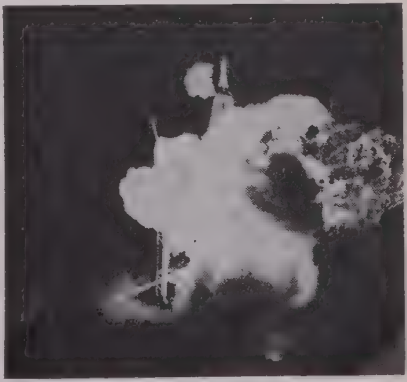
In many cases the lowest bidder does not turn out to be the lowest priced contractor in the long run. There are companies that will submit the lowest bid just to get the contract. Once they have the contract and start working, they will renegotiate for more funds for one reason or another. They always seem to find a loop hole.

Also, in connection with the latter, the materials supplied by the low bid contractor, even after higher renegotiated costs, do not meet performance or reliability objectives as the company who had originally bid higher but who had been more realistic, sincere, and honest in their original bid.

Still another situation: If the contractor attempts to exceed the performance requirements of the applicable specification, he will usually be forced to raise his price above that of his competitor. He is thus forced to limit himself to the level of performance specified or thought acceptable, even though he has the capability of greatly increasing the performance of the system and improving its reliability.

Thus it would be well for Congress to re-examine present procurement regulations with a view toward allowing greater leeway or flexibility to the procuring agencies so that their activities would not be completely confined to an absolute low bid philosophy.

Some effort to modify procurement procedure has been made in the past in purchasing highly reliable



LOST MONEY

Here an Atlas fails because of poor reliability. This failure represents the loss of many tax dollars.

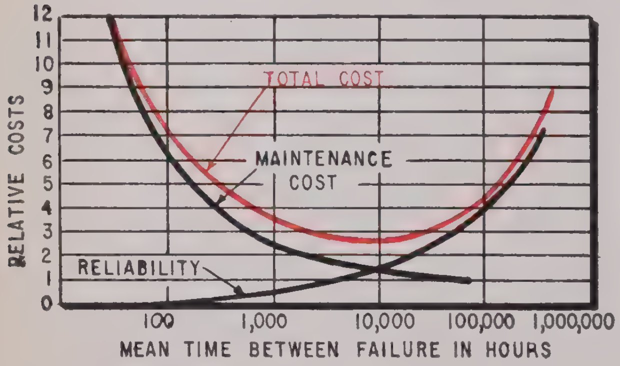
(*Photo courtesy of Autonetics*)

equipment. One solution that has worked well is as follows: The procuring agency selects several companies who, they believe because of past experience or manufacturing capability, can handle a particular contract. These companies are then oriented on the equipment requirements.

After orientation the companies prepare a set of specifications which describe what they will supply and the procedures they will follow. The technical information supplied is then reviewed by a board of engineers and technical specialists. The board selects those which have presented a good sound approach and rejects the others. Those that have been selected are asked to bid. The lowest bidder then receives the contract.

There is difficulty with this method, however. The companies supplying these technical proposals do so with their own money. Obviously, only the one receiving the contract can recoup its outlay. It would be, of course, desirable if all of the selected companies making a bid could receive some funding to offset the cost of preparing the proposal.

Another item that current congressional procurement policies overlook is the cost of maintaining purchased electronic equipment and systems. Money for this is usually allocated from a separate fund, and might be called operating funds. Many cases have shown that the real major cost is not the original cost of the equipment but is rather the cost of keeping it functioning. It is quite possible to have an initial purchase cost of $3 million coupled with a maintenance cost of $4 million. Maintenance, of course, is directly proportional to failure rate or lack of reliability. If initially $1 million more had been earmarked for reliability, and this in turn reduced maintenance costs by say $1.5 million, then it is easy to see how substantial savings can be effected in overall equipment costs.



OPTIMUM POINT

Graph shows how maintenance cost decreases as reliability increases. Note that there is an optimum point where the total cost is held to a minimum. However, under some circumstances, this optimum point may have to be exceeded.

Few-of-a-kind systems

In the past the electronic industries supplied equipment that was designed essentially for consumer or entertainment use. Radios, television sets, and phonographs have relatively high degrees of reliability, but this reliability has been achieved through time and through proven manufacturing techniques. Government procurement on the other hand frequently involves the design and construction of "few-of-a-kind systems." It is extremely difficult to provide adequate reliability levels in such systems because of the limited time factors and because of the testing costs involved. With the most stringent testing techniques, the cost of parts and equipment can quite easily exceed the original cost of the equipment.

Pushing-the-Art

Now, suddenly, the electronic industries are looked to as a principal source or means of acquiring world leadership in offensive and defensive weaponry, and in space exploration and conquest. There is thus a great tendency to put laboratory or developmental items into operational equipment ahead of time. Reliability suffers when the state of the art is pushed because the items involved have not been tested or used over a sufficiently long period of time. On the other hand, maximum use of each new development must be made if leadership is to be retained.

The premature use of new art also presents other problems. Electronic technology is quite new in comparison to some of the other arts, professions, and sciences. There are new discoveries daily. The older arts and sciences have comprehensive handbooks, reference charts, and guides for engineering reference. In the electronic field, full information of this type is not always available. As long as this industry continues to be so volatile, the compilation of such needed technical reference information will always lag far behind. On the other hand, as more and more information retrieval systems come into being, some improvement in this situation can be expected in the future.

Usurping Patent Rights

Another problem that hampers the cause of reliability is the procurement requirement that patents and manufacturing know-how developed on a government contract become government property. Clauses in most contracts issued today stipulate that all work done, all patents obtained, and all equipment used on a particular system or part must be turned over to the procuring agency and become government property. Here are some typical examples:

In 1946 Congress passed the Atomic Energy Act. Title 42, Section 2182, states: "Any invention or discovery useful in the production or utilization of special nuclear material or atomic energy, made or conceived under any contract, subcontract, arrangement, or other relationship with the Commission, regardless of whether the contract or arrangement involved the expenditure of funds by the Commission, shall be deemed to have been made or conceived by the Commission."

In 1958, Congress passed the National Aeronautics and Space Act. Section 305 says in effect that any invention made in the performance of any work under any contract with NASA, whether or not it was made during working hours, or whether or not the inventor was employed or assigned to work on the invention, such invention shall be the exclusive property of the United States.

Currently before the Senate is S.1084, a very short bill, which says simply: "That the United States shall have exclusive right and title to any invention made by any person in the performance of any obligation arising from any contract or lease executed or grant made by or on behalf of the United States." And just in case there is room for the slightest misinterpretation of this statement, it is then added in reverse form, as follows:

"Notwithstanding any law, custom, usage of practice to the contrary, no invention resulting from a research contract or grant financed by the United States shall be patented other than in the name of the United States and no patent resulting from such a contract or grant shall be issued, assigned, or otherwise transferred to any person, corporation, or association as compensation under any such contract or grant." That is the whole bill.

Now in preparation S.1176, which establishes a new government agency to administer this huge portfolio of patents. It sets forth the staff and its salaries, its procedures, the way it will grant to any person a non-exclusive royalty-free license for the use of any patent held by the U. S. in exchange for a payment of $25.00, the way it will have the right to look over each new patent before it is issued by the Patent Office to determine whether it would like to keep it or not, the kind of new paragraph to be inserted in all government contracts, and a retroactive power under which the new Administrator may claim title to any invention up until five years after its issuance.

These restrictions frequently tend to cramp and limit the output product and the initiative and incentive of manufacturers. Consider for a moment the relationship when you buy a television set, a radio, dishwasher or an automobile. Here the manufacturers of these objects are not required to supply more than the necessary operating and service information. They do not have to tell you how they made this equipment, or where they obtained all of their materials. Above all, know-how patents developed in the making of the product become proprietary information for use in future operations. Thus electronic manufacturers face entirely different concepts and controls in performing on government contracts.

Proprietary interests are protected on consumer products. On government or military products, however, manufacturing know-how may be usurped via secondary contracts by competitors.

Every so often we read in the newspapers about government spending investigations because a part available in a local hardware store for 29¢ is costing $1.10 through government procurement. A few days later we read about "nickel and dime parts" being the cause of missile failures.

While not always obvious, both of these news items point to the same thing. First, you cannot get reliability without paying for it.

This is a foregone conclusion. Secondly, these "nickel and dime" parts that caused missile failures caused them because they were nickel and dime items. The point is, that probably these nickel and dime parts did come from a local supply house. The fact that the two parts appeared to be exactly alike, one costing 29¢ and the other costing $1.10 proves that parts cannot be judged by price alone.

It is disturbing that one segment of the government is complaining about low-priced parts in the hardware store, instead of through high reliability vendors. This attitude of price above all else is crippling to our defense and industry's economic growth.

Squelching Creativity

Often, to do the best job of designing a particular piece of equipment or system, a company will use an item they have been manufacturing (a proprietary item) for many years. Once they put this into military equipment or a system, they must turn over the plans for this item for use by other manufacturers making this equipment. They do not make any profit on the item even though it was designed and built prior to the present contract. In essence, they have lost their patent rights.

Another point: A company has an idea, has had the idea for years, for increasing production or better design of an item. However, because they lacked funds, they could not follow through. When they receive a contract they can then go to a bank and borrow the money to follow through on the original idea. When they use this on the contract, they must turn over the idea along with the rest of the information. Many manufacturers are reluctant to do more than required because of this.

ANY CLIMATE

With this environmental equipment any climate can be simulated. It is necessary to test parts and equipment under all operating conditions for reliability assurance. This equipment is costly and contributes to the slightly higher price of reliable items.

(Photo courtesy of Burroughs)

Achieving Reliability *(Continued)*

Work in Depressed Areas

There is one other that has, on occasion, stifled obtaining reliable equipment. This is the government's policy of placing work in depressed areas or "depressed companies." This is a commendable practice and we are not against it, provided the organizations are capable of supplying material or equipment as good as their competitors. Placing a contract in a depressed area or company, because it is such, is very poor practice where high reliability is concerned. We feel sure that there is other work of a lesser scale that can be placed there. In some cases, depressed areas or companies are depressed because they lack the necessary skilled or professional personnel to do the jobs of today.

To the Defense Agencies . . .

We should all recognize the fact that the military or procuring agencies play the role of middlemen. Congress is after them to cut spending; industry is after them to spend more. To some people, no matter what the military or procuring agencies do they will never be right. In most cases, this is unfair. However, we would like to point out some things to the military that they should be aware of.

Unfortunately, present specifications can be interpreted in almost as many ways as there are people who read them with a view towards becoming suppliers. Sometimes this is due to a misunderstanding and sometimes it can be deliberate. Reliability means many things to many people. To some reliability is synonymous with dependability. It can mean that reliability is an attribute which implies the ability to perform repeatedly in a specified or predicted manner. To others, reliability is a statistic which defines a fraction of total performances which are satisfactory. Economists view reliability as:

1. The cost of checking delivered parts.
2. The cost of part failure during assembly.
3. The cost of equipment testing after assembly.
4. The cost of field maintenance of the equipment.
5. The cost to the user when the product fails.

Each step costs more money than the preceding step and the final step can reach staggering proportions to the user.

How the Bidder Must Think

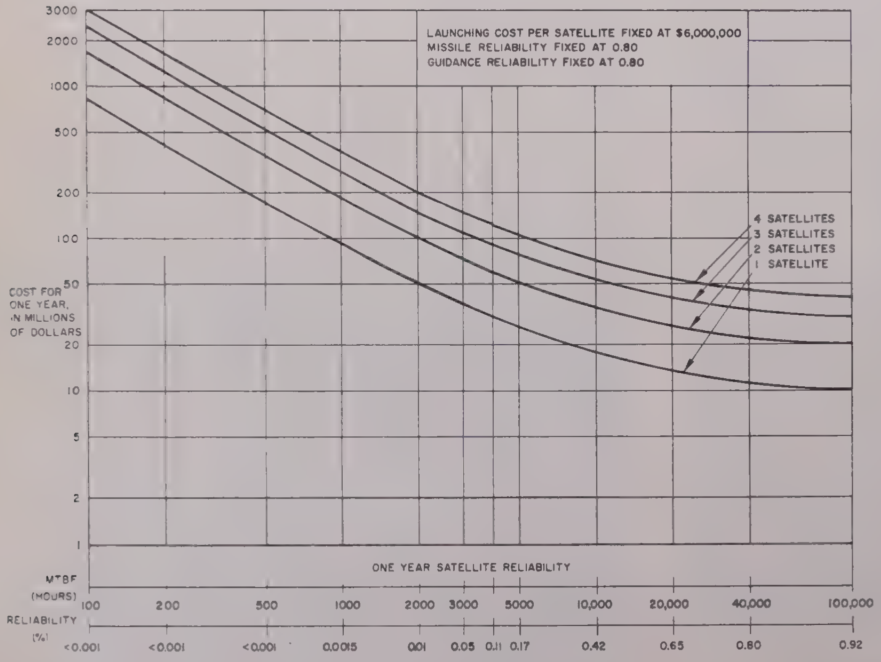
The bidder, when he prepares his bid, must take into account the qualifications and past performance of the people against whom he is bidding. If he is bidding against a true cross-section of our industry, he realizes that some of his competitors have maintained very high standards, as they affect reliability. Some bidders have been willing to sacrifice reliability interest in order to lower cost and thereby gain a portion of the business. This forces the other bidders to make an economic evaluation of the trade-off between cost and reliability.

It is the responsibility of the military departments and the DOD to develop complete and uniform specification requirements, without any loopholes, so as to insure that all bidders work from the same base. As we mentioned previously, reliability means many things to many people. By "tightening" the specs. and requirements we can force them all to think of reliability in the same light.

Incentives & Penalties for Bidders

Changes in competitive bidding aspects would assist in achieving higher reliability. Part of the changed bidding system should incorporate incentives for the contractor to produce higher levels of reliability. Also, there should be penalties—probably monetary—for any contractor who fails to meet the requirements. The military services have already made steps in this direction. However, these steps must be more definite. The military should get tough with contractors who fall down on their obligations.

Before "letting a contract," the military should be responsible for looking into several areas of a company. Among the things to be looked into are: the company's integrity; their background as far as past

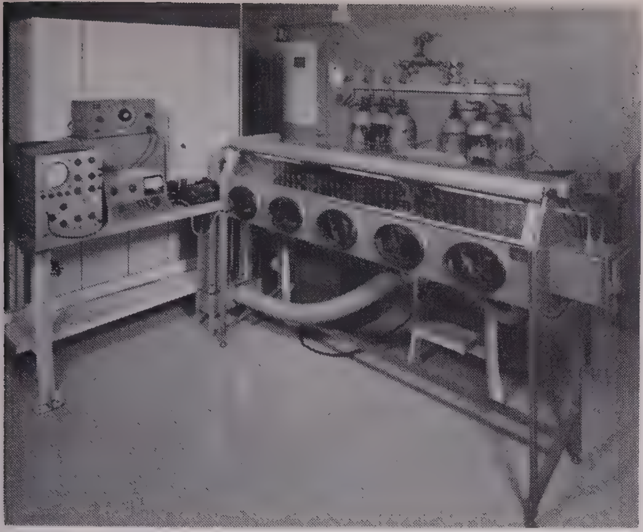


RELIABILITY SAVES MONEY

Curves show operating costs vs. satellite reliability levels. Unless exceptionally high levels of reliability are achieved, the costs of maintaining satellite systems becomes prohibitive. The first year costs shown are the sum of initial launchings plus the costs of replacing failed satellites.

(Drawing courtesy of Hughes)

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.



NO CASES

This specialized equipment is being used for accelerated life testing of uncased transistors under varying conditions.

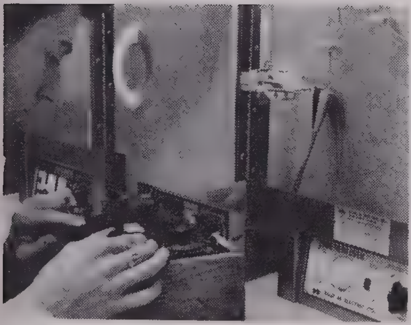
(Photo courtesy of Burroughs)

Testing, Testing, and More Testing!

ONE BY ONE

Semiconductor diodes are tested for stability while being vibrated. With voltage applied, the scope will show mechanical defects. The scope is mounted upside down for operator ease in viewing.

(Photo courtesy of Pacific Semiconductors)



HOT TESTING

Selected samples of all manufactured lots are subjected to high temperature exposure to assure meeting thermal stability specs.

(Photo courtesy of Bourns)

KNOB TWISTER

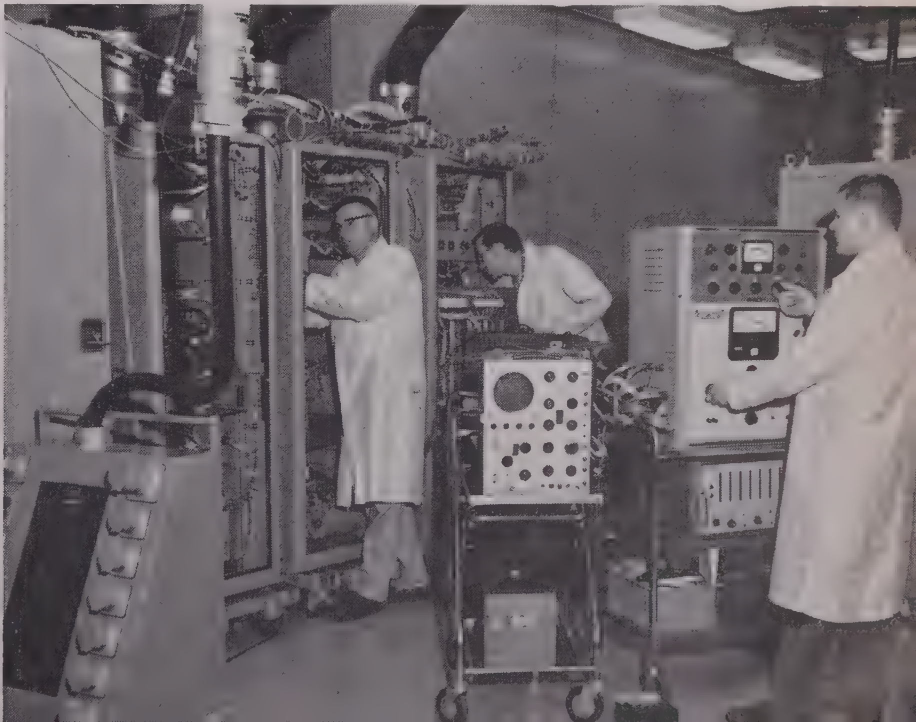
This device tests potentiometers for total resistance, tolerance, end settings, continuity, electrical noise and insulation resistance while rotating pot.

(Photo courtesy of Bourns)

GET READY

To assure reliability, parts, subassemblies and complete units must be checked and tested throughout their manufacture. Here one such test is about to start.

(Photo courtesy of Boeing)



performance goes; their manufacturing capabilities; and their willingness to supply the equipment at the best possible price. When we say best possible price here, we don't necessarily mean the lowest available bid. Where a new company is involved, they may not have a past performance. This should not be held against them. However, a more detailed check of them would be in order.

Stop Overspecifying

In some cases the military overspecify their requirements. Before specifying the desired level of reliability, the application of the equipment or system should be given very thorough consideration. For instance, radio equipment operating in a jeep does not require the reliability level of a missile. It is possible to repair or replace the equipment in a jeep, whereas once a missile is launched, that's It!

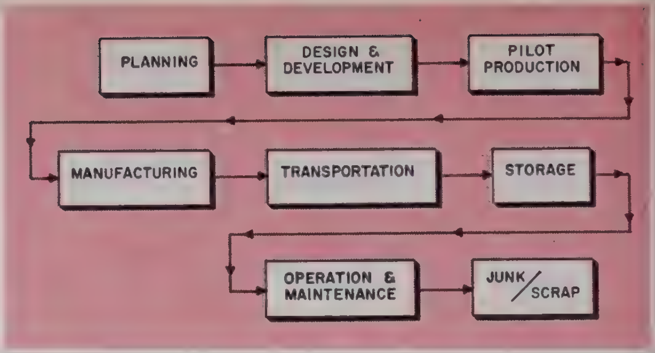
Often it is not recognized that reliability begins with the overall system specifications. Thus, there is a great tendency among the specifiers of systems to require the equipments to be capable of handling marginal situations. Such requirements cause the equipment to have built into it, capabilities of performance and versatility which increase complication, cause individual elements to operate closer to limits, and render the use of standardized, proven, lower performance components very difficult.

Plan Properly

The first phase of any program is the planning stage. The expression of required reliability in quantitative terms is needed to provide a common basis for comparing the reliability of one part with another's and with the reliability demanded by military usage. Whatever quantitative term is used, it must have a sound statistical meaning, and the meaning must be the same in all specifications. The present low level of reliability may be partly ascribed to the failure to do so. In the past, a manufacturer who designed a new system had to meet certain *performance* specifications. However, he was under no legal obligation to include reliability among these. As a result reliability has been treated as an afterthought.

Reliability can be, and is, improved throughout production, but the maximum that can be achieved is limited by design. The failure rate of electronic equipment cannot be appreciably decreased by debugging. High levels cannot be achieved unless this factor is taken into account during the planning stage. Requirements should originate with the groups responsible for the operational requirements and military characteristics of the specific services. It is through these groups that the services determine how they intend to accomplish their mission. The figures decided upon by the services must then be put into the development contract for new equipment.

Proper planning is the foundation on which the reliability structure is based. We have heard it said that the cost of writing reliability requirements into specifications should be at least 10% of the total spec. writing cost. Any requirements for numerical reliability should be considered one of the most important and critical sections of procurement specs. Actual numbers can be determined by a feasibility study. Once these levels have been set, they must be maintained. In the past, companies have defeated reliability requirements by obtaining waivers.



THE LIFE SPAN

The block diagram shows any piece of electronic equipment from its initial inception until it is laid to rest.

To the Manufacturer . . .

From the foregoing, it is obvious that for the electronic industry to grow and be respected, our pricing must be fair to us and our customers. We must know what's required before bidding, and be sure that we can meet the requirements.

Every contractor should accept the fact that he is not qualified to design, develop and manufacture all types of components and equipment. He has a moral obligation to stay away from bids and orders that he honestly cannot handle.

For survival in the future, your company's integrity must be above reproach. In some of the new military specs that are coming out, integrity of your company will be one of the evaluation points used when issuing contracts. Also, when the contract is available for bid, do not bid on it unless the requirements are realistic and you have an honest scheduling date. Otherwise, you will not be able to fulfill the contract and hence do yourself, and the industry in general, a great deal of harm. Now, enough has been said about this aspect. Let's look into how industry can obtain higher levels of reliability.

You Must Want Reliability

Reliability begins with a management's determination to make the best components possible. This determination and desire then must be instilled in employees. Rigid discipline must be exercised. Employees must understand that if a unit is not 100% as it should be, it is to the company's benefit that it is discarded.

One of the problems is getting people to "think" reliability. For instance, we heard of a janitor who found a component lying on the floor in the shipping room. The unit was defective, but he picked it up and threw it in the hopper, where others were being readied for shipping. This act of ignorance can have far-reaching effects. The manufacturer loses prestige, and business, and his reliability and quality control programs look bad. Eventually this part may go into a piece of equipment where a failure means heavy financial losses to the user because of down-time.

The farther this part proceeds along its path before detection, the more money is lost.

Traditionally, the main objective of industrial organizations is to direct employees so as to optimize their output. For reliability, the objective is to direct employees so as to optimize "trade-off" between the probability of equipment failure and other factors—performance, schedule, and cost, etc.

Management's function is to provide all employees with the data, methods, skills and formalized management controls that are needed to optimize this "trade-off" between reliability and other governing factors. The program should be based on working backwards from analyses of failures that have occurred.

A Good Reliability Organization

A reliability organization, encompassing not only quality control but also all other elements of the reliability equation is necessary for any modern program.

Such an organization should be charged with the staff and service responsibilities of any reliability program.

The company reliability program should be headed by a reliability director. He should have centralized functional control over the various reliability groups in his company, and should report directly to the general manager or company president.

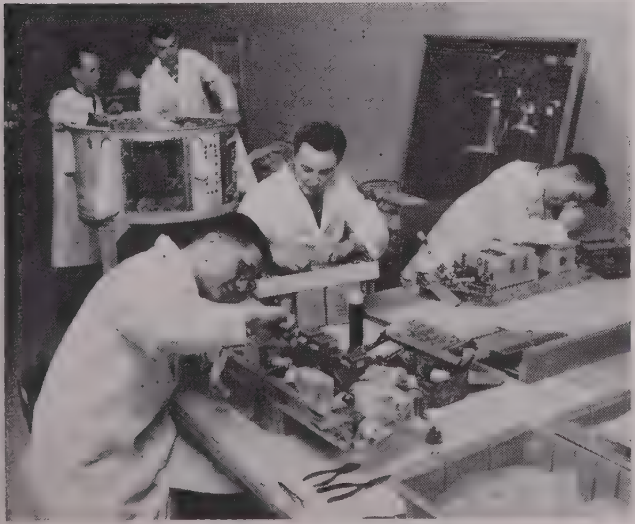
The organization must be responsible for establishing, modifying and monitoring the reliability program. The broad system must include definition of procedures by which the purchaser's specifications are met, as well as the means by which unusual or special reliability goals are reached. The scope of the organization ranges from definition of reliability objectives, through development of methods for reliability analysis and design review, and even to preparation of clear and accurate drawings, instructions and process specifications.

Organizational forms are merely ways of arranging skilled groups to facilitate their effectiveness. The skilled groups themselves are fundamental. However, if specific skills are not defined and developed, no amount of organizational juggling will produce an effective program. You cannot buy reliability by just hiring a reliability engineer.

KEEP IT CLEAN

Cleanliness is a prerequisite for manufacturing reliable electronic equipment. Components and equipment must be protected from foreign matter at all times as illustrated.

(*Photo courtesy of Boeing*)



Composition of a reliability organization should include statisticians for design of experiments and analyses, a laboratory for reliability testing, systems engineers to ascertain effects of any change in performance, kill probability, safety factor, etc., reliability applications engineers to link hardware, design and mathematics. The organization's objective is to improve reliability by design, which is achieved by providing information to engineers and other employees.

CONSTANT TESTING

Components must be checked throughout the manufacturing cycle. Many times the manufacturer must design his own test equipment to do the job, such as this push button filter tester.

(*Photo courtesy of Burnell & Co.*)

Also, it should perform meaningful analyses and experiments to show management where the greatest technological efforts must be extended to yield the most profitable results.

A basic program providing technology, skills, organization and management methods is a necessary foundation for rapid and economical accomplishment of project reliability programs. A logical sequence of five types of reliability activity provides such a foundation. These activities are:

1. Perform failure analyses. From this identify controls that reduce employee errors that contribute to equipment failure.
2. Perform research to develop qualitative knowledge of physical modes of failure. Develop methods for prediction, control and measurement of failure rates.
3. Develop and apply physical methods for obtaining quantitative failure rate data for current equipments.
4. Establish an employee understanding of, and sympathy for, reliability by provision of training, motivations and manuals.
5. Integrate technical reliability knowledge with the authority of line supervision by preparation and issuance of reliability directives.

Reliability directives should define *what* will be done and *how* it will be done. The project program plan should add *which* directive will be applied to each item; *when* each task will be done; *who* will do it and *how much* it will cost.

It must be recognized that reliability is not an end in itself. It is one factor in providing the customer with the capability that he must have, at minimum total expense. This means, that although the price of research, development, or manufacture may be increased by a reliability program, the total cost of the equipment plus installation, maintenance and operation must be reduced. Hence, the objective, in the end, would be cost effectiveness.

From the foregoing, it should be obvious that to design and manufacture reliable products with minimum cost of time and money, deliberate action must be taken by management to organize for reliability. Many groups lack the necessary authority and responsibility to achieve reliability. As long as this weakness exists, it is virtually impossible to achieve the high reliability required today.

Engineering & Reliability

Reliability must be considered in the primary design stages. Here is where the specifications are reduced to drawings, material lists, process specifications, test instructions, handbooks, and training programs. It is here that many of the basic decisions are made which will determine the cost, size, performance, operability, and reliability of the final product.

Certain individuals should review all engineering decisions from the reliability standpoint. Such a review might consider the following factors:

1. Proper selection of components and materials.
2. Proper use of components and materials to permit satisfactory safety factors and circuit designs based on derated components.
3. Control of environmental factors by proper provisions for heating, cooling, shock mounting, hermetic sealing, fungus protection, mounting, protection from humidity and protection from electrical interference. Reliability of the environmental controls, such as cooling system pumps and fan motors, must not be taken for granted.
4. Analyses of impedance values of circuits with respect to the effect which these values have on electromagnetic pick-up or circuit interaction.
5. The analysis of the effect of condensate on circuits and provisions for desiccating or draining this condensate.
6. Analysis of the effect of tolerance build-up on equipment, performance and reliability.
7. Mechanical analysis of the load stresses, backlash and deflection.
8. Proper placement of components on circuit boards for easy assembly and to avod interaction.
9. Minimization of the number of contact devices, such as connectors, relays, slip-rings, commutators, and switches.
10. Reduction of the number of different kinds of components—and using standard components.
11. Make operation as simple as possible to minimize the chance for human errors.
12. Incorporate good provisions for repair and maintainability.
13. General adherence to standards and good practice.

The design review should also assure that all essential disciplines (controls) have been followed, and that all known modes of failure have been considered, and safety margins provided for them. Good design cannot be overstressed. Here's where reliability begins—and can end! Poor design now cannot be patched up later with a quick fix.

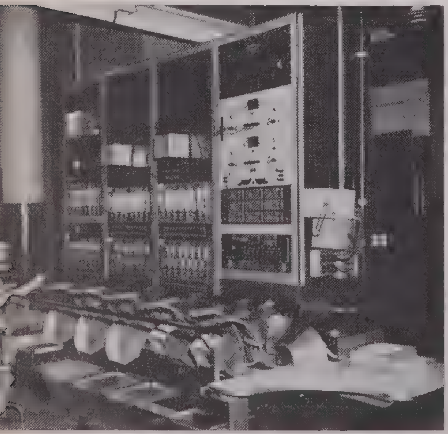
When designing for reliability, designers must know exactly how the equipment or components will be used. The operating conditions and environments to be met are very important in good design. Operation must be known and understood. For instance, if the equipment is going to be stored, this must be considered as a condition of reliability, the same as operating conditions.

Some organizations have a nasty habit of requesting equipment or materials for a certain environment and then expecting these to work in an entirely different surrounding. When the equipment or material fails to work there, the purchasing organization is quite upset about it.

Designers should try to stick to standard parts and circuitry. And, the number of parts should be kept

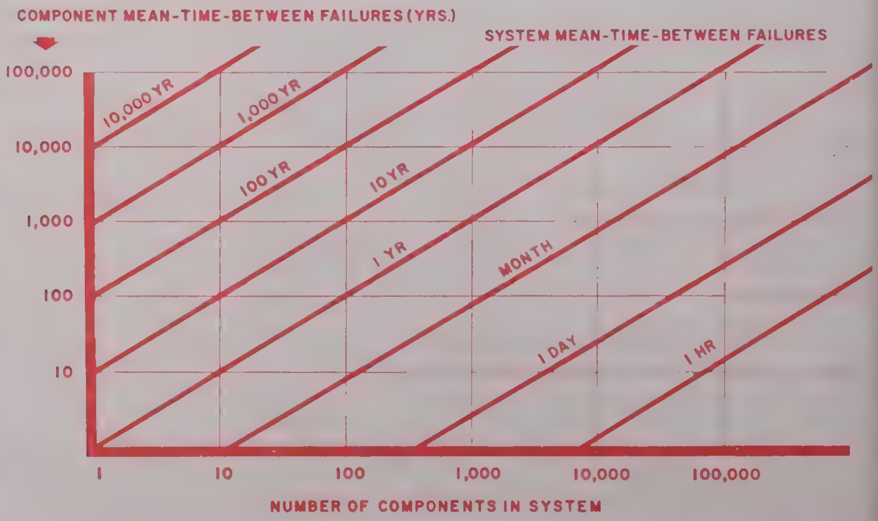
AUTOMATIC TESTER

Production tester tests and categorizes 3,600 transistors per hour for 20 parameters. It eliminates all human errors.
(Photo courtesy of Philco)



THE OPERATING LIFE

As the number of parts decrease or the mean-time-between parts failures increase, the life of the system increases.
(Drawing courtesy of Autonetics)



to a minimum; the number of parts has a direct bearing on reliability.

Redundancy is a method of improving reliability by paralleling two or more parts so that failure of one part will not make the equipment inoperative. It is a necessary evil, and recommended only for critical parts where every effort to achieve the required component reliability has failed. Redundancy has many failings—added parts increase the probability of failure and there are the penalties of added weight, size, and cost.

Be Careful of Production Changes

Extreme caution must be exercised in production changes. Production employees must not be permitted to show their individualism in the manufacturing processes. Their decision-making, in production operations, should be held to an absolute minimum. Curiously enough, production employees usually get to like stringent controls. They know the part or unit that arrives at their location is good; they do not have to compensate for someone else's errors or sloppy workmanship.

Prevent Failure Recurrence

A prime goal is the prevention of failure recurrence. Reliability programs should aim at preventing every type of failure that occurred in the past. A check of failures shows that rarely are they new.

Formal failure reporting systems have been developed to provide statistically significant data. Data is used for guiding logistic and tactical action, for evaluating contract performance, and for providing information on "modes of failure." Data will also pinpoint production and "people created" failures.

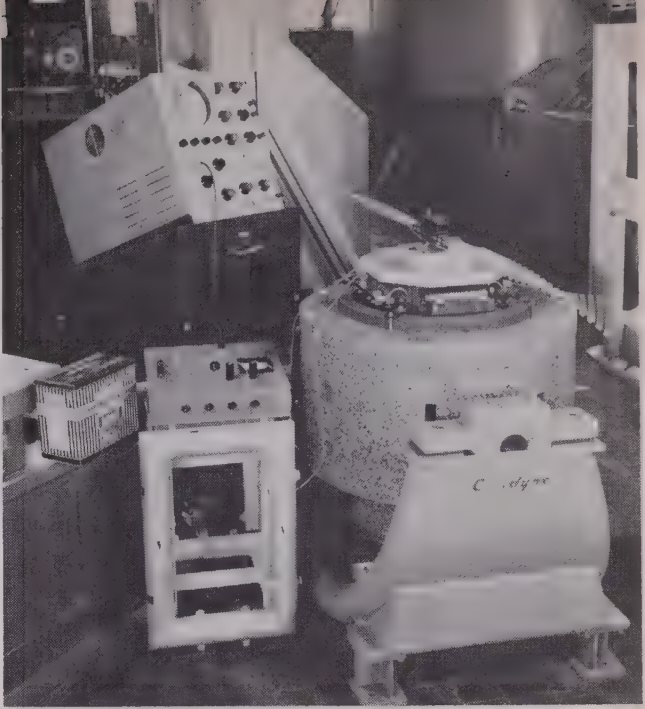
The "modes of failure" information is important for understanding physical failure phenomena. However, it does not provide a good basis for preventing failure recurrence. It is necessary to extend failure analyses to include "management discipline analyses." This extension is needed because management cannot control the laws of physics; they can control only the actions of their employees.

The steps of management discipline analyses are: First, to identify any controllable employee actions that contribute to the failure; second, to identify the procedures that are being or can be used to control these actions; and third, to decide whether improvements in the procedures or in motivation of employees to use them are required to prevent recurrence.

The result of thousands of failure phenomena and failure analyses have led to these conclusions:

1. The most basic cause of unreliability is manufacturing variants.
2. Quality control methods discover most variances, but some escape.
3. Design stresses and tolerances determine the probability that the variances will become failures.
4. User stresses, if greater than assumed by the designer, increase failure probability.

Process or human failures in the plan, and human or equipment failures in the field should be reported, through a data system, to a responsible engineering, manufacturing and quality control team. Increased use of failure experience will lead to better control of manufacturing processes, to more specialization of the work of each manufacturing operator, and to more exact definition and instructions to each operator and inspector. Finally, the reliability experienced should be continuous with that depicted; not only to discover potential improvements, but also to predict reliability in future systems.



(*Photo courtesy of Burroughs*)

LET'S SHAKE IT
Vibration test apparatus is very important for testing electronic equipment under severe operating conditions.

About Vendors . . .

The preferred component supplier is the one that has provided a very large number of uniform parts to the field, and the use experience was all good. If your engineering group has not had experience with the company's products, then someone else's experience is the next best thing. Such background tells you that the reliability is apt to be good, even in your application and that the manufacturer keeps a constant design, and fixed application methods, and produces a uniform product in large quantities. At least, if he does not, the field data will usually so indicate.

The degree of automation employed in part fabrication, the good name of the manufacturer and his integrity, and the excellence of his quality control group, are considered important. This company's reliability activity, as may be pertinent to your use, should be examined also.

The above indicates a gloomy aspect for new manufacturers and new products. Let us find out about such new products and applications that are reliability sensitive. When there is no other way than to use an untried part or one from a new manufacturer in a sensitive application, then a personal visit to his plant is in order. First one tries to understand the product and how it is made. Then there should be a study of the idiosyncrasies of manufacturer and the indication of shrinkage figures. A feeling for the quality control records is very helpful. And not the least, is the study of the product shortcomings, causes and mechanisms of failure.

Scoring systems for rating vendors have a useful place in quality control activities. Many such scoring

Achieving Reliability *(Continued)*

systems yield a benefit to reliability as well as quality, and those employing scoring systems should be encourged to further develop this technique. However, the scoring forms should not preclude a visit to the new vendor by reliability engineers.

Reliability should not be overspecified. Overspecification can be expensive. Again, know what is needed.

Incoming Material Inspection

Each individual equipment manufacturer must establish his own system of assuring component reliability. The fact that they have a part made under the same conditions as another reliable project, does not insure reliability. To insure a good level means installing plant testing systems, computing, and checking systems comparable to those used by the component manufacturer. Proper storage and handling must be maintained at the buyer's plant.

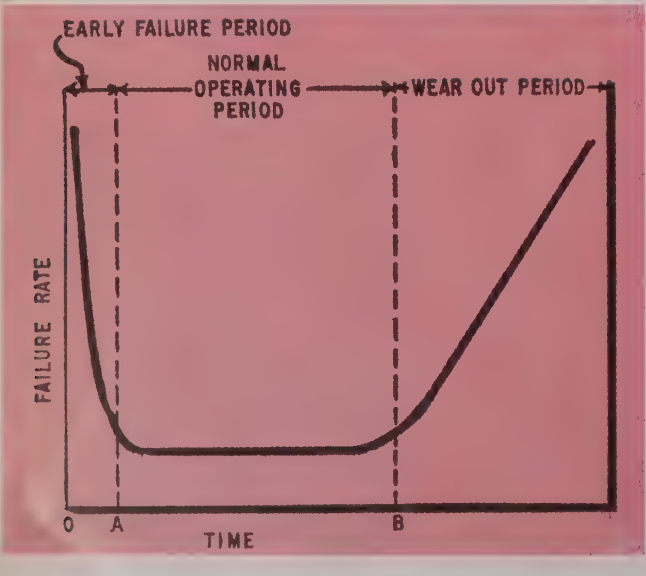
On the component manufacturing end, each component should be identified by serial or batch number. Then the equipment manufacturer must keep track of where these parts are used. If a particular batch should show bad, then each one can be located and replaced as required.

It is very important to know that the product of interest is qualified to perform in the application intended. Sometimes we know this to be beyond any doubt because of recent field experience with the same part, in an equally rigorous application. Other times, we may note that the vendor is on the Qualified Parts List for a part which is covered by MIL specs. This may be no protection, as procedures for periodic requalifications are not yet activated, and early techniques for original qualifications sometimes left much to be desired. The general shortcomings of the present MIL Specs, with respect to reliability, are very well covered in the Darnell Report.

In short, if you do not have unmistakable field evidence that the part of interest is capable in the intended application, qualification tests, perhaps specially designed for the purpose, must be run.

THE FAILURE RECORD

Equipment and components have a high failure rate initially and then reach a satisfactory operating level. The aim is to minimize early failure rate and increase operating time.



Questions often arise concerning source inspection, customer inspection at the manufacturer's plant, and regular incoming inspection. Critical parts need attention to this general problem. Acceptance inspection requirements and procedures employed by the manufacturer, at the manufacturer's plant should be reviewed and if found wanting, then augmented or rewritten. They should be examined for assurance that they guarantee part performance in the way in which the part is to be used.

Further, such tests should make use of test equipment which is on hand at the manufacturer's plant and, preferably, which is also on hand at the customer's plant if calibration procedures and programs are in existence. It should be clear as to disposition of any units which do not meet the minimum specification requirements.

The presence of sound and thorough acceptance requirements greatly assist military source inspection when this is required. If the part is really critical, it may be well to provide quality assurance personnel, for observation during acceptance programs, at the manufacturer's plant. No matter how thorough or complete the manufacturer's acceptance procedures, such activity does not negate the value of incoming inspection.

Determine Part Adequacy

It is essential that the user be prepared to determine the adequacy of any critical parts procured on the outside. It is necessary that the user know how to determine this adequacy, and he should have experience in so doing. It is well to remember that the acceptance tolerances, as employed at incoming inspection, must be wider than those used by the manufacturer to avoid improper parts rejections.

Acceptance requirements should be spelled-out in detail. There should be no question that a unit passing complete acceptance requirements will later pass incoming inspection at the user's plant. If sampling plans are to be allowed, then carefully specify all necessary reference information. Incorporate or reference an acceptance test procedure which goes into detail to define an acceptable unit, the conditions of test, and the type of inaccuracy of test instrumentation. Require instrumentation to be regularly processed on a periodic calibration cycle.

All user-prepared procurement specs need a section on quality assurance provisions, such as is contained in preferred military-specs. This section should contain requirements for qualifications inspection and for acceptance inspection. If any reliability assurance provisions are to be included, they should also be in this section.

"Vendor Visibility"

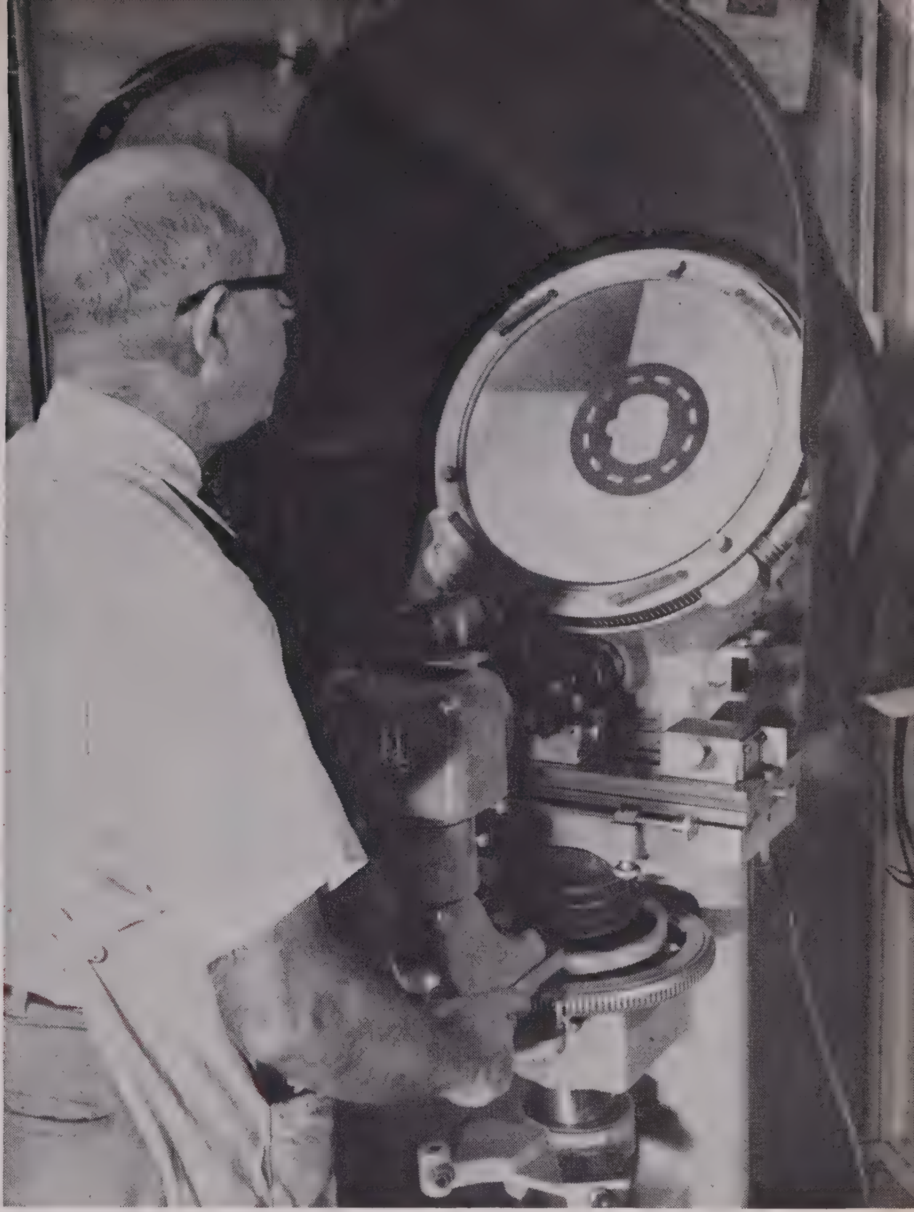
Component manufacturers, when dealing with high reliability, are often required in the contract to permit equipment or prime manufacturers to visit their plant and to do a thorough survey of their operation. This is sometimes called "vendor visibility." Some vendors refuse to permit this. One reason is the fear

CHECKING CALIBRATION

Test equipment must be checked on a regular basis to prevent variances in tolerances during product manufacture.

(Photo courtesy of Bourns)

Quality Control at Work



WATCH THE DIMENSIONS

A comparator is used to check pieces struck from a punching die to prevent die wear from creating tolerance changes.

(Photo courtesy of Synthane)

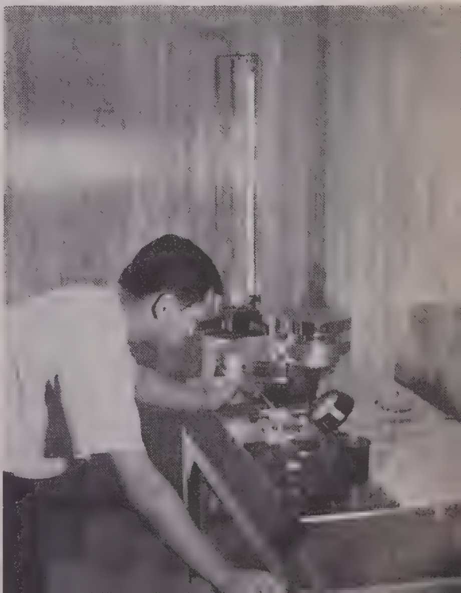
A CLOSE CHECK

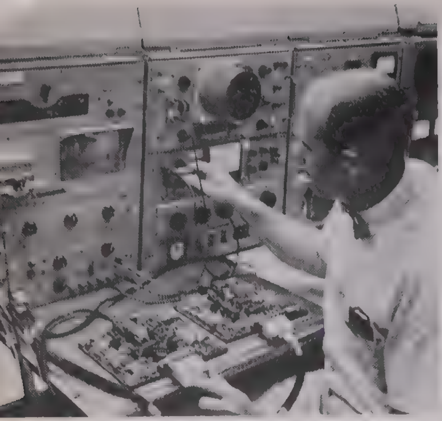
A microscopic inspection is made of an element. This inspection checks weld termination, uniformity of wire spacing, and freedom from overlaps or excessive gaps in wire turns.

A PRIMARY REQUIREMENT

Pressure calibrating equipment is checked against a primary standard. Here, a dead weight tester checks the accuracy of the weights used in calibrating and testing high pressure instruments.

(Photo courtesy of Bourns)





NEXT STEP

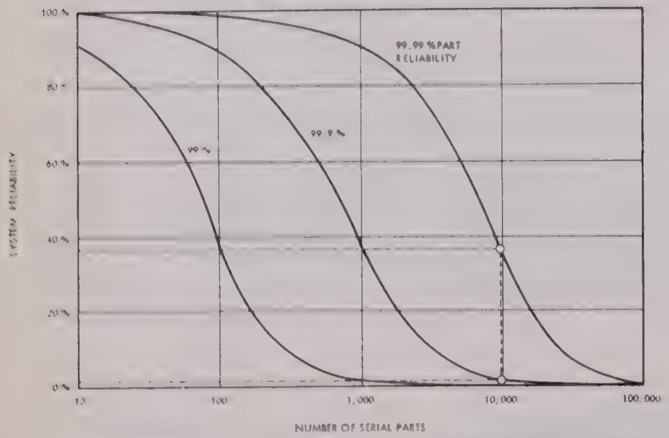
An engineer wires a guidance system power supply to a test stand, then turns to a Videosonic® unit (left, center) for instructions on completing the test. These units speed up production and eliminate almost all employee mistakes.

(Photo courtesy of Hughes)

FAILURE ANALYSIS

High reliability programs require each component to be tested. Any that fail during testing are studied to determine what caused the failure and the necessary corrective action.

(Photo courtesy of IRC)



(Drawing courtesy of Hughes)

ON TARGET?

System reliability, in percent, vs. the number of serial parts (the critical parts that must work in order for the system to perform its function). Upper broken line shows that about 6 out of every ten missiles would fail.

WHAT'S COOKING?

This is the rear view of a thermal test chamber used to make load/temperature tests on high reliability diodes. Tests facilities can handle 500,000 units at one time.

(Photo courtesy of Pacific Semiconductor)

that they will note the lack of reliability and quality control. Another is the fear of losing trade secrets.

The equipment manufacturer or prime contractor usually does not want to run the business, but they do want to watch and see that the supplier does a good job for them. Like it or not, the component manufacturer is going to be subjected to this more and more.

Some component manufacturers report that once they have their line set up for high reliability, and the kinks and bugs are removed, then their yield increases. This yield means a better return for their dollar and with production, can cut the cost of the reliable parts.

Equipment manufacturers should guard against the possibility of designing around hand-made parts. There have been cases where equipment has been designed around a sample batch of parts. When production was started it was found that these could not be supplied in quantity with the parameters or level of reliability required. This can be chaotic.

Component Testing

In determining modes of failure, environmental test selection is important. Precise testing is necessary. Environmental testing requires a knowledge of the operating environment as we mentioned earlier. In finding the causes of failure, there must be a highly sensitive means of detecting, and then analyzing the failure. There are techniques of observation whereby an engineer can make some preliminary examinations of a component.

The observing engineer can often spot the major or more common errors in manufacture. However, he cannot test them for 100% reliability. The buying engineer can draw some erroneous conclusions if he is not extremely careful about his tests. For instance, an engineer can apply heat to a device to check for thermal breakdown. However, he could be led to a false conclusion. The heat source he used for testing may also be an infrared source, and the product tested may not have been designed to handle infrared exposure. Hence, it appears to fail with less temperature than is claimed.

Subassemblies and assemblies must also be subjected to testing until failure. However, the purpose of testing these is to discover failures caused by specific assemble effects, such as local resonance, ambient temperatures and poor workmanship. Therefore, testing of these items is recommended only after it is certain that parts of extremely high reliability have been employed with an adequate margin of safety. Otherwise, this type of testing becomes very cumbersome, while barriers attributable to part unreliability mask these caused by assemble effects.

Don't Forget Instruction Books

Instruction books, too, have a very real effect on reliability. Instruction books are used by both equipment operators and maintenance personnel. These books must be written in a clear concise manner so that they cannot be misunderstood. Poor instruction books can cause improper operation, poor preventive maintenance, or greatly increase repair time. This can be considered a failure just as surely as any component failure.

Particular attention must be paid to instruction and maintenance books supplied to the military. Here the personnel generally lack the needed skills. The lack of skills is related directly to the high turnover of personnel. About the time a man is capable of "earning his keep" his enlistment is up. This problem has plagued the military.

The manual preparation group should be on the project from the start. Manuals should be available with the equipment. The best designed equipment can be worthless if the user does not know how to operate the equipment or what to expect from it.

Packaging & Shipping

Packaging and shipping of equipment is part of the reliability and environmental role. Many factors must be considered. As an example, we heard of a dental officer who was sent a portable field dental setup to test and evaluate under field conditions. When he received it, he had it kicked off a truck tailgate and then submerged in a stream for two days. It was then uncrated in a rough-shod manner. Needless to say, the equipment was in shambles before ever being used. While this may seem extreme, it is one of the conditions that must be considered.

Reliability or Else!

A good organization and production setup is going to cost money. This must be recognized now. The money to do this will have to come out of the company's pocket. The initial expenditure may reflect in the dividends paid to stockholders. However, they can be "educated" to accept this fact. After all, like it or not, your company is and will be in a battle for survival.

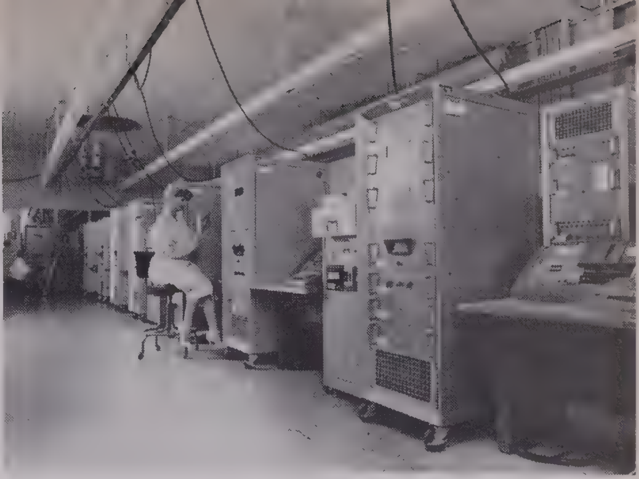
Only a limited number of companies will establish themselves successfully as high reliability suppliers, and these will capture an increasing, and ultimately predominant, share of the total market within the next decade. There are a number of reasons why this is likely to prove true. In the first place, there are strong forces compelling the user of components to deal with the least number of suppliers necessary to assure a flow of adequately reliable products.

It is difficult and expensive to maintain the required kind of association with suppliers, and the risk of failures increases rather than decreases as the number of suppliers goes up. There is a risk associated with unusual dependence on a single supplier, but this risk diminishes greatly as the second supplier is added, and disappears when there is a third.

Conclusion

We have discussed the weaknesses in the three areas of responsibility. From these it should be obvious that:

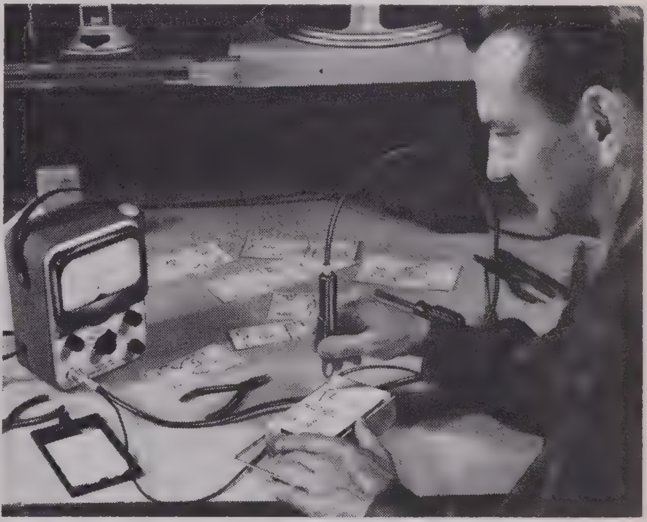
1. Congress develop an understanding of the problem and its possible solutions. This will enable them to give better and more intelligent support to military electronic programs for reliability, perhaps even down to changing the methods of procuring material and equipment.



(Photo courtesy of Pacific Semiconductor)

A COMPONENT'S PEDIGREE

Many high reliability programs require a punched card for each component manufactured. Among other things, this card contains complete test data. Proper handling and processing of these cards necessitates a large data processing system.



(Photo courtesy of Philco)

SIMPLIFYING REPAIRS

Ease and speed of repairs must be considered as a part or any reliability program. Here "Trace," a visual service guide, is placed over a printed circuit board and the marked pattern traced with a meter. It accelerates field repairs.

GOOD INSTRUCTIONS

Well written instruction books must be considered part of a reliability program. The best designed equipment is useless if the equipment user or maintenance man does not have the necessary information. Here an engineer and a tech. writer are discussing material to be included in a manual.

(Photo courtesy of Burroughs)

Achieving Reliability *(Concluded)*

2. The military should understand the requirements they have and when they require super-reliability. They must know how to specify reliability and where to obtain it. If there is any doubt about the supplier, then they must investigate thoroughly.

3. The manufacturer must participate in reliability programs. By participation he aids the country, as well as himself, through economic growth and better defense of our country. In the future, those that fail to do so may not be in business.

Acknowledgments

In preparing this article, to cover all sides, we spoke to people in each of the areas discussed in this article. We wish to thank them all for their assistance. Special thanks must go to several people for spending an exceptional amount of time discussing the technical side of Reliability with us. In mentioning their names, we must point out that the foregoing views are not necessarily the views of these people or their companies.

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Dr. Leslie W. Ball, Director of Reliability, Boeing Aero-Space Division.

William T. Sumerlin, Manager, Engineering Reliability and Components Dept., Philco Corporation.

Norman Burnell, President, Burnell and Company, Inc.

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Norman Kutner, Supervisor, System Reliability Section, Burroughs Corporation.

J. Y. Bowman, Reliability Director, and Robert E. Moore, Autonetics, division of North American Aviation.

S. J. Sutherland, Transducer Div., Servomechanisms, Inc.

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28. W. T. Sumerlin, "Reliability Methods for Manufacturing Operations and Customer Acceptance," delivered to ASQC-Rutgers Symposium, May 10, 1960.

29. C. M. Ryerson, *RCA Reliability Program and Long Range Objectives,* published by Engineering Products Div., March 15, 1955.

30. W. T. Sumerlin, "Can the AGREE Reliability Program Benefit Guided Missiles," presented at the Joint Military Industry Guided Missile Reliability Symposium, Pt. Mugu, November 5, 6, & 7, 1957.

31. W. T. Sumerlin, "Reliability Testing of Airborne Electronic Systems and Components," presented at the 1951 National Conference on Airborne Electronics, Dayton, Ohio, May 25, 1951.

32. Guy Black, *A Critical Survey of Electronic Component Failure Rates,* Technical Memorandum No. EDL-M175, January 31, 1959, Sylvania Electric Products Inc., Mountain View, Calif.

33. W. T. Sumerlin, "Quantitative Reliability Acceptance Testing (AGREE)," 3rd National Reliability and Quality Control Symposium, January 1957.

34. *Reliability of Military Electronic Equipment* (AGREE Report), June 1957.

35. Victor Harris, "Aspects of Reliability," presented at the Eighth National Electronics Conference, September-October 1952.

36. Jerome E. Toffler, "System Reliability, What it is and Why," *Electronic Industries,* July 1959 issue.

37. J. H. De Frenne, "Planning Dynamic Reliability," *Electronic Industries,* May 1959 issue.

38. Denham Scott, "Vicious Procurement Practices in DOD?," *Aircraft & Missiles,* June 1960 issue.

reliability
in
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CLEVITE TRANSISTOR
WALTHAM, MASSACHUSETTS

How to select power transistors

by RICHARD F. MOREY, JR.

Manager, Applications Engineering, Clevite Transistor Division of Clevite Corporation

A basic understanding of the interrelationship of transistor design parameters facilitates selection of the most advantageous unit for a given application.

Transistor characteristics depend upon each other. Consequently, a design change in the manufacture of a transistor directly affects a number of its electrical characteristics.

As a guide to users of power transistors, several of the important design elements and the electrical characteristics they influence have been summarized in chart form (fig. 1).

The curves (figs. 2-5), show typical characteristics for two power transistors of quite different design. Clevite's 2N1762, for example, is a 3 ampere unit having the following design parameters: Small junction area; high resistivity germanium; moderate germanium lifetime; average wafer thickness and no emitter doping.

In contrast, Clevite's 2N1146C is a 15 ampere power transistor which has several quite different parameters based upon a higher current and power requirement; large junction area several times the size of the 3 ampere unit; identical base width and resistivity but longer germanium lifetime and thicker wafer plus aluminum doping to increase emitter efficiency.

Working with the chart in figure 1 and the table, figure 6, we see that the comparative design elements of the two transistors result in the 15 ampere unit exhibiting:

- lower thermal resistance and higher leakage currents because of its large junction area.
- slightly lower collector to base voltage.
- higher gain because of the emitter doping and higher lifetime.
- very linear current gain out to high currents because of its large area and special emitter doping.
- lower collector to emitter breakdown voltages because of its higher gain and lower collector to base voltage.
- much lower saturation voltage and base input voltage because of its high gain and thicker wafer and larger area.
- low common emitter frequency response because of its high gain and large area.

Effect of Transistor Design on Characteristics

DESIGN PARAMETER	Addition of Emitter Doping	Increase in Wafer Thickness	Reduction in GE material lifetime	Increase in GE material resistivity	Reduction in Base Width	Increase in Junction Area
THERMAL RESISTANCE R_T	—	—	—	—	—	decrease
COLLECTOR LEAKAGE CURRENT I_{CBO}	—	decrease	increase	increase	—	increase
COLLECTOR BASE VOLTAGE V_{CB}	—	—	—	increase	—	decrease slightly
COLLECTOR EMITTER VOLTAGE V_{CE}	decrease	—	increase	increase	decrease	decrease slightly
D.C. CURRENT GAIN h_{FE}	increase	—	decrease	—	increase	—
LINEARITY OF h_{FE}	better	—	—	—	—	better
SATURATION VOLTAGE $V_{CE\,(SAT)}$	decrease	decrease	increase	increase	decrease	decrease
BETA CUTOFF FREQUENCY f_{ae}	decrease	—	increase	—	increase	decrease
PUNCH THROUGH VOLTAGE V_{PT}	—	—	—	decrease	decrease	—
SECONDARY BREAKDOWN CURRENT I_m	increase	increase	—	decrease	—	increase

Figure 1.

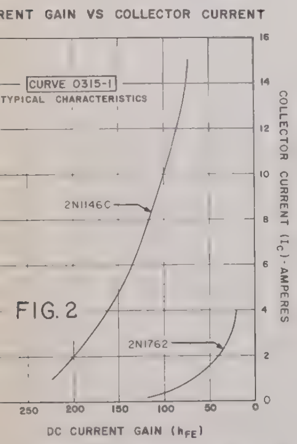


FIG. 2

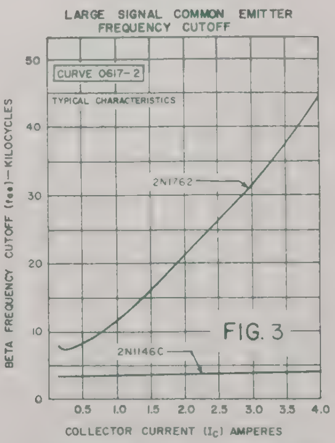


FIG. 3

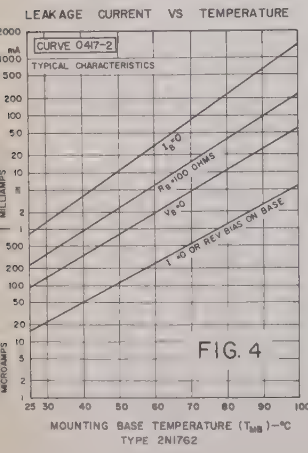


FIG. 4

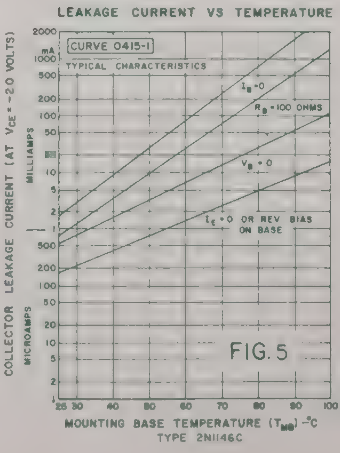


FIG. 5

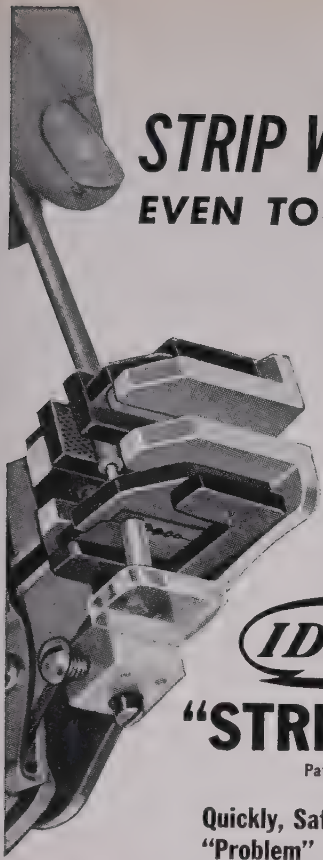
Comparison of Characteristics — Two different designs

Characteristic	2N1762 Typical Value 3 Amp. Device	2N1146C Typical Value 15 Amp. Device	Units
Thermal Resistance	1.4	0.5	°C/watt
I_{CBO} at 100V at 85°C	3	15	mA
I_{CBO} at 100V at 25°C	1	4	mA
BV_{CBO}	130	120	Volts
$V_{CEO(sus)}$	70	50	Volts
Current Gain at I_C = 1 Amp.	60	220	
Current Gain at I_C = 5 Amps.	15	140	
Current Gain at I_C = 15 Amps.	—	75	
Saturation Voltage at 3 Amps.	0.3	0.2	Volts
Saturation Voltage at 15 Amps.	—	0.4	Volts
Saturation Resistance	100	26	Milliohms
Frequency Cutoff at 1 Amp.	18	4	kc.

Figure 6

In order for circuit designers and users of power transistors to obtain the best combination of electrical characteristics, the requirements for the application must be well known and be matched to the transistors available on the market. Therefore, an elementary knowledge of the existing relationships between transistor characteristics is a useful design tool. A tabular summary of characteristics for Clevite's complete line of power transistors is available. Ask for Bulletin 61-A.

CLEVITE TRANSISTOR
Waltham, Massachusetts



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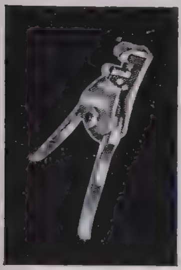

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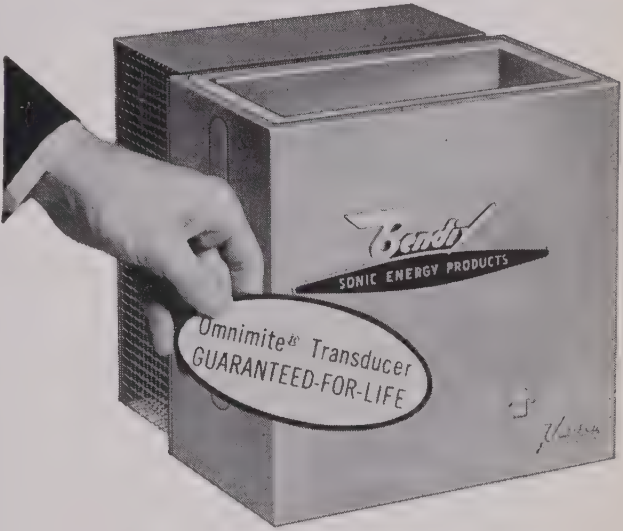

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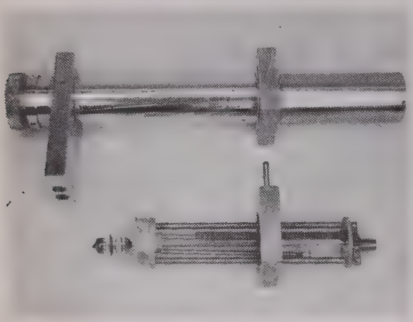

Operating freq. is from 400 to 1000 MC. When used with 2C36 or similar UHF triodes, 10 mw of power into a 50 Ω load is achieved. A ruggedized anti-backlash tuning mechanism retains accuracy and resetability under severe shock. The oscillator is the heart of the Model TS418 Signal Generator which is both CW and pulse modulated. Entire unit designed to conform to Mil-E-5400. Frequency Standards, P. O. Box 504, Asbury Park, N. J.

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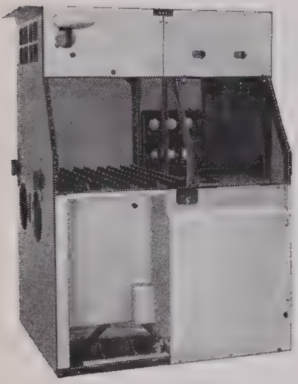
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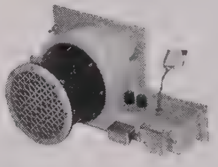
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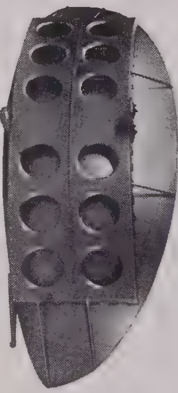
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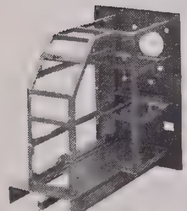
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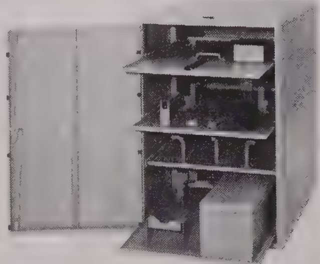
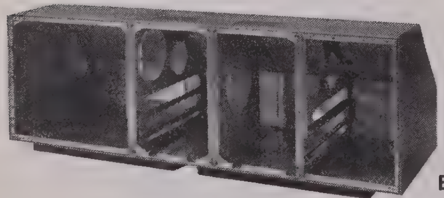

Storage Cabinet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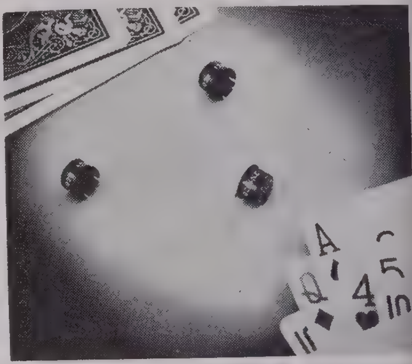

These transistors, type numbers 2N1924, 2N1925 and 2N1926, are immediately available from stock in production quantities. In addition to voltage ratings up to 60 v., the transistors have a high gain characteristic. Thus, they may be used in audio freq. switching circuits as well as high voltage amplifier circuits. General Electric Co., Semiconductor Dept., Kelley Bldg., Liverpool, N. Y.

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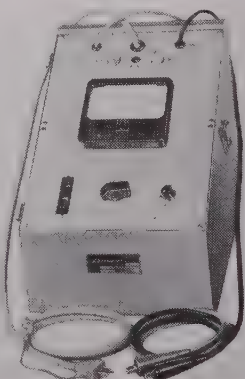
NON-DESTRUCTIVE TESTERS

For relays, wiring, small transformers and printed circuit boards.



Twenty-two models available wit output voltages from 0-1500 v. to 0-1 Kvac, suitable for testing to ASTM NEMA and UL specs. All model furnished with 5 ft. long input cord 5 ft. high voltage output leads wit clips, continuously variable voltag control, breakdown indicator and ad justable leakage indicator. All unit feature completely dead front con struction for max. personnel safety Davenport Mfg. Div., Duncan Elec tric Co., Inc., Dept. ES2, 2530 N. El ston Ave., Chicago 47, Ill.

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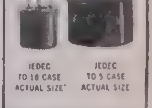

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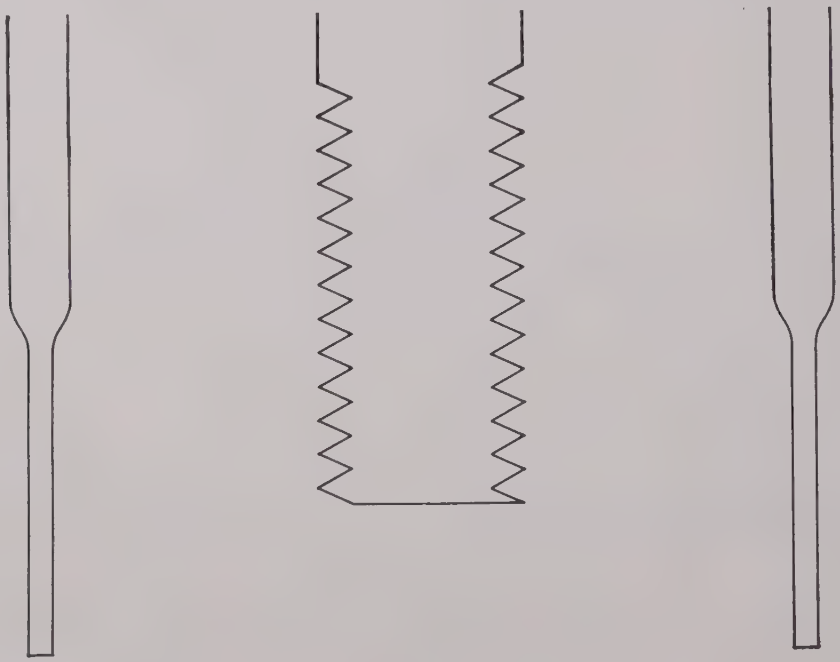

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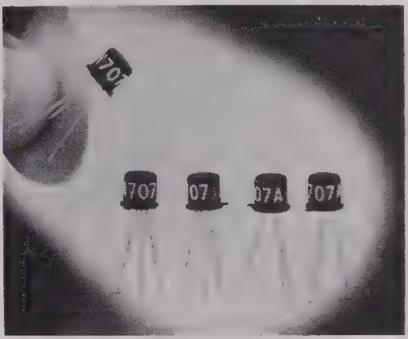

Epitaxial mesa, type 2N707A has a collector-base voltage rating of 70 v. and a power dissipation of 1 w. Is intended for VHF oscillator and Class-C amplifier use. Capable of oscillating at freqs. in excess of 600 MC, the 2N707A features a low typical collector saturation voltage of 0.18 v. and collector capacitance of 4 pf. Motorola Semiconductor Products Inc., 5005 E. McDowell Rd., Phoenix 8, Ariz.

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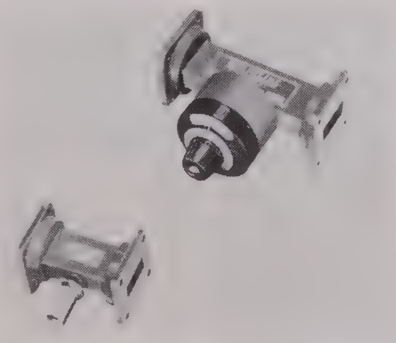
Precision waveguide units for lab or in systems design use.



Shielding is provided for interference free operation at low r-f levels even in areas of exterior high level fields. The standard calibrated units provide an attenuation range of 30 db. with calibrations provided at 5 db. points at a single freq. (Model 611 covers 8.20 to 12.4 GC; Model 711 covers 12.4 to 18.0 GC). The standard variable pad attenuator provides an attenuation range of 20 db. (Model 613 covers 8.20 to 12.4 GC). Waveline Inc., Caldwell, N. J.

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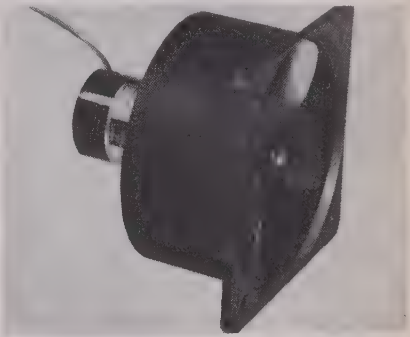
MINIATURE BLOWER

Axial unit delivers 15 cfm @ 0.2 in. of water at 3600 RPM.



Power requirements: 1 ϕ, 117 v., 60 CPS source. Blower is enclosed in a precision cast aluminum housing for max ruggedness. Continuous operation life is rated in excess of 2500 hrs.; unit is designed to meet appropriate MIL specs. Mounting flange dimensions are 3.44 in. sq.; bolt holes spaced 2.75 in. apart. Overall length is 3.25 in. Weight: 12 oz. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

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TAPE HEAD DEMAGNETIZER

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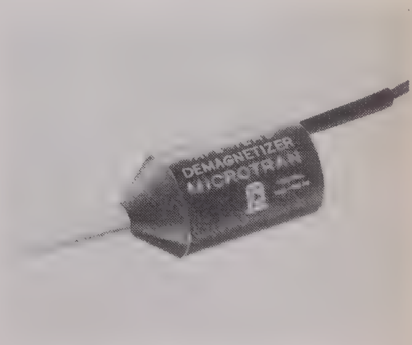

This unit will remove permanent magnetism, reduce noise level, reduce harmonic distortion, improve signal to noise ratio, insure high freq. response, and reduce hum of tape head. A special finish is provided on the pole piece to prevent marring of record head surface. Unit is molded of high impact epoxy and sealed for life. Size: 4 x 1¼ in.; Weight: 7 oz.; Rating: 117 vac, 1 a. Microtran Co., Inc., 145 E. Mineola Ave., Valley Stream, N. Y.

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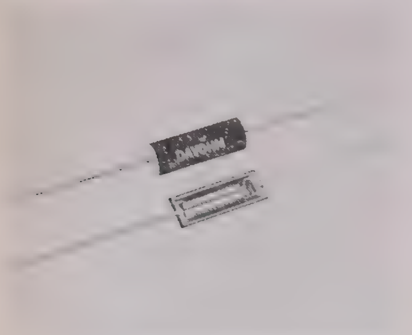

Resistors, Types DA2 and DA4, exceed all electrical and mechanical requirements of Styles RN-65 and RN-70 respectively of Mil-R-10509D, Characteristic C. Over temp. range of −65°C to +175°C, all resistors show the same resistance change as allowed in Mil-R-10509D, Characteristic C (50 ppm). Over temp. range −65° to +175°C, selected resistors show same resistance change as allowed in Mil-R-10509D, Characteristic E (25 ppm). The Daven Co., Livingston, N. J.

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PLASTIC FILM CAPACITORS

Type SS precision standard units now rated from 0.5 to 1 mf.

The range includes capacitances of 0.6, 0.7, 0.8, 0.9, and 1 mf, all with a tolerance of ±0.1%. In new case but with same height and width dimensions, 2 5/16 x 1 9/16 in., respectively, as the 0.2 to 0.5 mf values. Still adaptable to the multiple, plug-in adding technique. Other specs: Insulation resistance, 10 GΩ min.; Temp. coefficient, 105 ±10 ppm/°C; Long term stability ±0.05%; Dissipation factor, 0.0005 max. Arco Electronics, Inc., Community Dr., Great Neck, N. Y.

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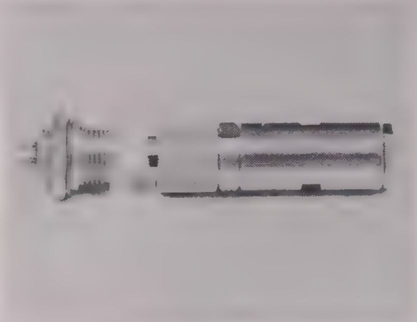
MINIATURE PLUGS

TM (Twinax Miniature) replaces 2 plugs by combining power leads.



They are designed for subminiature uses involving a common shield over a twisted pair of wires, or for requirements involving 2 power leads. Identical inserts with either male or female contacts used for both plug and receptacle. Inserts can be removed for bench soldering, and are assembled into the plug shells before the clamping parts are assembled. Conventional saddle clamps available for non-shielded wires. Cannon Electric Co., 1943 Placentia Ave., Costa Mesa, Calif.

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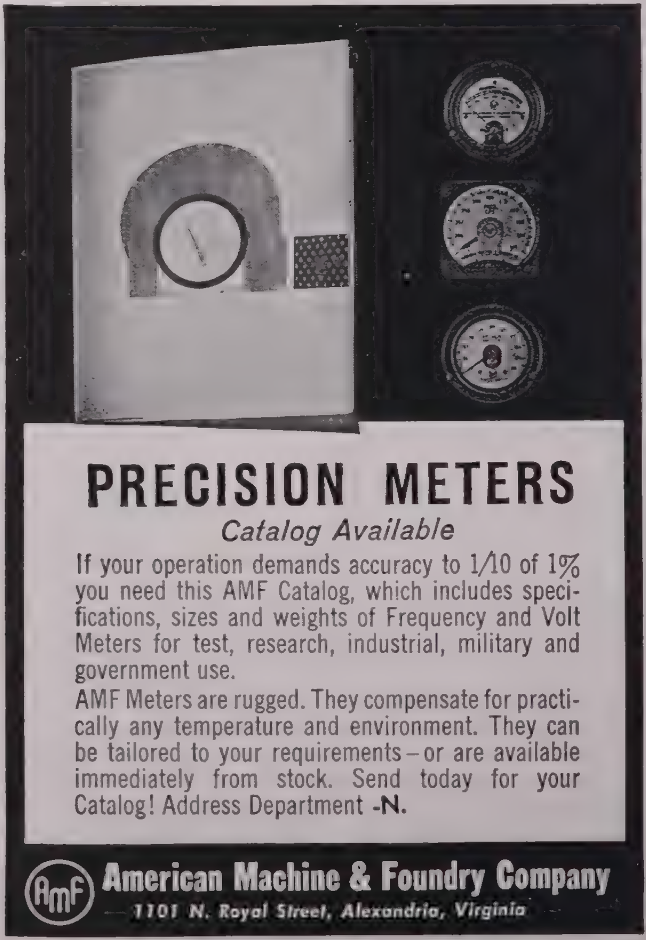
PRECISION METERS

Catalog Available

If your operation demands accuracy to 1/10 of 1% you need this AMF Catalog, which includes specifications, sizes and weights of Frequency and Volt Meters for test, research, industrial, military and government use.

AMF Meters are rugged. They compensate for practically any temperature and environment. They can be tailored to your requirements—or are available immediately from stock. Send today for your Catalog! Address Department -N.

AMF American Machine & Foundry Company
1101 N. Royal Street, Alexandria, Virginia

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DEUTSCH
CONNECTORS®

- **DM Series**—push-pull, meets Mil-C-26482
- **DS Series**—push-pull, insertable, removable, crimp contacts
- **DTK Series**—bayonet lock, meets or exceeds applicable requirements of Mil-C-0026482A
- **DRS Series**—rectangular rack and panel, advanced application performance
- **DC Series**—push-pull, environmental, crimp-type RF connector
- **DM and DH Hermetics**—glass to metal seals, leak proof glass to metal seals

24 Hour Delivery
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Circle 89 on Inquiry Card

FOR STEREOPHONIC FM RECEIVERS

LENZ

"MULTIPLEX"

DOUBLE CHANNEL AUDIO CABLE

for STEREO

- BROADCAST RECEIVERS
- CONVERSION EQUIPMENT
- TAPE RECORDERS

NOW THAT THE FCC HAS SHOWN THE GREEN LIGHT FOR STEREO FM BROADCASTING, manufacturers of receivers and other audio equipment will find LENZ prepared to supply "MULTIPLEX" Cable (code no. 17555). This double channel audio cable was designed especially for connecting amplifiers to decoders in stereo receivers and conversion kits.

"MULTIPLEX" Cable consists of a pair of completely insulated, *color coded* conductors in a *small diameter* cable of *extreme flexibility*. Each conductor has a spirally wrapped, tinned copper shield that is used as a conductor. The *spirally wrapped shield is easily formed into a pig-tail connection.* Capacity is 30 uuf per foot.

You will find "MULTIPLEX" (code no. 17555) useful wherever you need a double channel connection.

Write for Complete Information and Sample Today!

LENZ ELECTRIC
MANUFACTURING CO.
1751 No. Western Avenue
Chicago 47, Illinois

LENZ

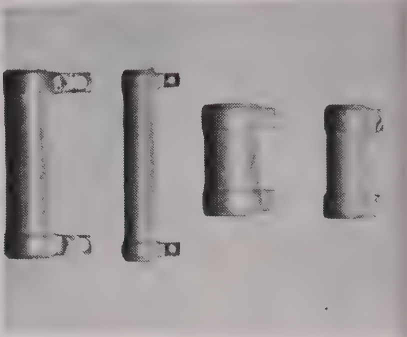
IN BUSINESS
SINCE 1904

Circle 90 on Inquiry Card

New Products

POWER RESISTORS

Radial lug components have advantages of vitreous enamel types.

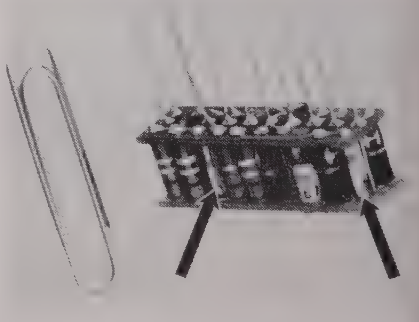


This is due to a new high temp. coating. Operating temp. range is from −55°C to 350°C. All sizes meet functional requirements of Mil-R-26C, Char. V. Six sizes in 4 wattages (5, 6, 7, and 11 w. at 25°C). Resistance ranges from 10 Ω to 200 KΩ, depending on size and tolerance. Tolerances: 0.05%, 0.10%, 0.25%, 0.5%, 1% and 3%. Temp. coefficient 20 ppm/°C. Dale Electronics, Inc., Columbus, Nebr.

Circle 299 on Inquiry Card

CAPACITORS

Cerafil® units, ¼ in. long available in 10-1000 pf capacities.

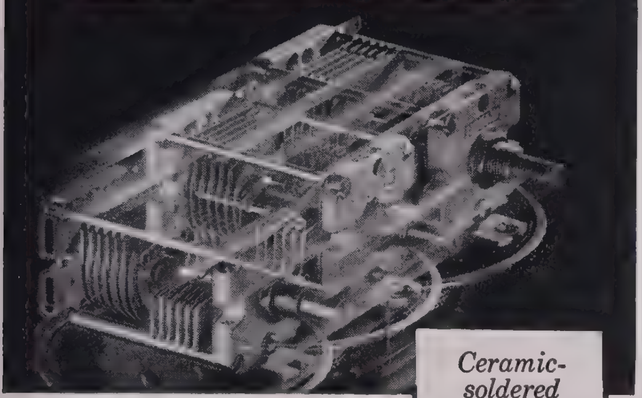


Use include sandwich-type circuit construction. Made in lacquer coated, durez coated or epoxy molded cases, depending on dia. and/or test requirements. Body O.D. 10 pf-1000 pf lacquer coated, 0.060 in. max.; durez coated 0.090 in. max.; molded 0.105 in. max. Placquer units can be made as high as a 100 vdc rating. The durez and molded units will meet Mil-C-11015B requirements when tested using Cerafil ratings. Hi-Q Div., Aerovox Corp., Olean, N. Y.

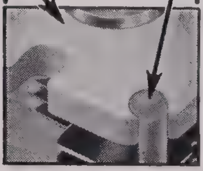
Circle 300 on Inquiry Card

THESE RUGGED JOHNSON VARIABLES WITHSTAND TERRIFIC

VIBRATION and SHOCK!



Parts can't break loose... capacity can't fluctuate!



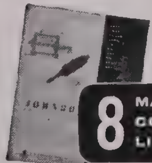
Set your frequency... these tough Johnson "L" variables will hold it—even under severe conditions of shock and vibration! Designed to provide outstanding strength, rigidity and operating stability—rotor bearings and stator support rods are actually soldered directly to the heavy 3/16″ thick steatite ceramic end frames. Parts can't break loose... capacity can't fluctuate!

Specially designed split-sleeve tension bearing and silver-plated beryllium copper contact provide constant torque and smooth capacity variation. Plating is heavy nickel—plate spacing .020″, .060″ and .080″ spacing as well as special platings, shaft lengths and terminal locations in production quantities.

A complete variable capacitor line... from tiny sub-miniatures to large heavy duty types!

From the tiny Type "U" sub-miniature, which requires less than 0.2 sq. in. for chassis or panel mounting—to the rugged heavy-duty "C" and "D" types . . . the Johnson variable capacitor line is designed for more capacity in less space—offers you one of the widest standard capacitor lines in the industry! For detailed specifications on all Johnson variable capacitors, write for your free copy of our newest components catalog, described below.

New Catalog



8 MAJOR COMPONENT LINES

Write today for our newest electronic components catalog—complete specifications, engineering prints and current prices on:

- CAPACITORS • TUBE SOCKETS • CONNECTORS • PILOT LIGHTS
- INSULATORS • KNOBS, DIALS • INDUCTORS • HARDWARE

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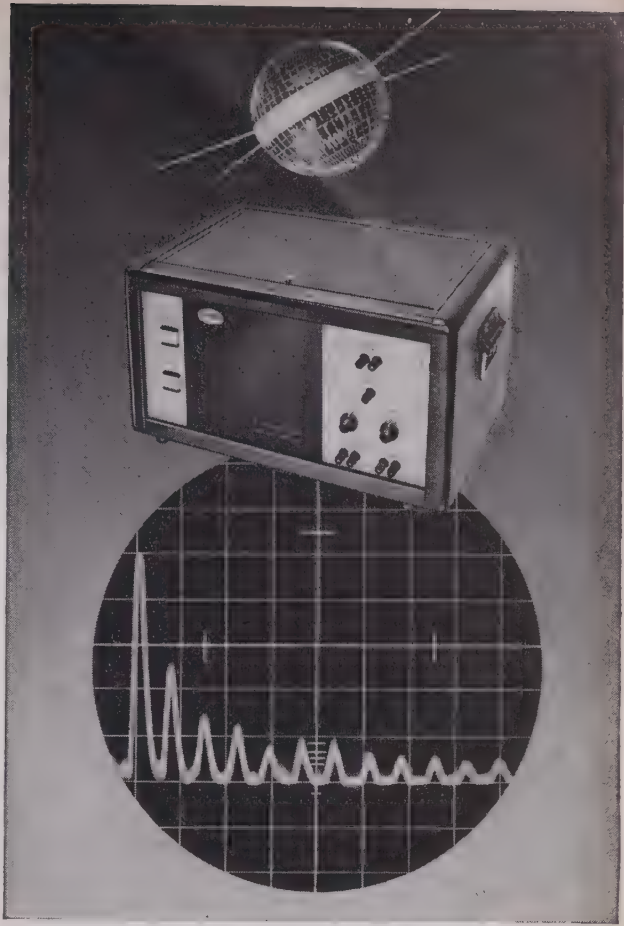
Circle 125 on Inquiry Card



High Speed • High Resolution High Sensitivity Spectrum Analysis with *Rayspan*

SPECTRUM ANALYZER

Raytheon Rayspan Spectrum Analyzers, through a unique application of multiple filters, can analyze entire spectrums as wide as 33 kc at scanning rates as high as 200 times per second with excellent resolution and a dynamic range of 40 db. Frequencies as low as 8 cps can be identified. Resolution for two equal-amplitude signals is approximately 0.7% or 3% of the analysis band depending on the Rayspan model employed.

Any model can be adapted for use with high speed, helix recorders to provide permanent records of frequency versus real time. A built-in timing pulse generator allows scan-by-scan synchronization of Rayspan with an oscilloscope.

For complete technical data please write to: Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.

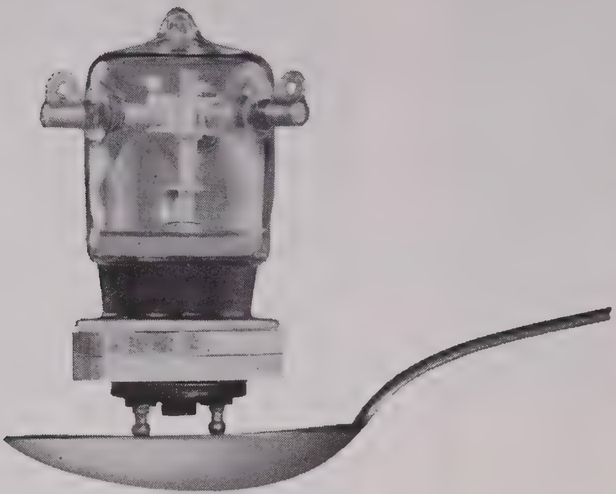
RAYTHEON

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION

Circle 126 on Inquiry Card

RELAY SHOWN ACTUAL SIZE



ANOTHER NEW RELAY?

Yes indeed—but not just another relay. This is our new RB1R SPDT vacuum relay, combining all the advantages of previous vacuum relays, plus new high speed operation and extremely long life.

See what this relay can do:

HIGH VOLTAGE: 18 kv peak test
HIGH SPEED: Over 100 cps
OPERATE TIME: 3 millisecs max.
RELEASE TIME: 5 millisecs max.
LONG LIFE: Rated 10,000,000 operations
HIGH CURRENT: 15 amps rms (60 cyc)

Versatile, too. Even in the area of power switching, not usually a feature in a relay of this size, this relay will interrupt 18 kw dc power for over 100,000 operations. (When either current or voltage does not exceed 3 amps or 6 kv). It may also be obtained with normal operating speeds and life at less cost. Or it is available as the type RC41-CR1 in a specially designed coax housing with a choice of several connectors for different power level requirements.

RC41-CR1

You will find this relay very useful for switching antennas, pulse forming networks, rapid data transmission, teletype speed control, or high voltage rectification.

Write for more detailed information on Jennings complete line of vacuum transfer relays.

RELIABILITY MEANS VACUUM / ***VACUUM** MEANS* Jennings®

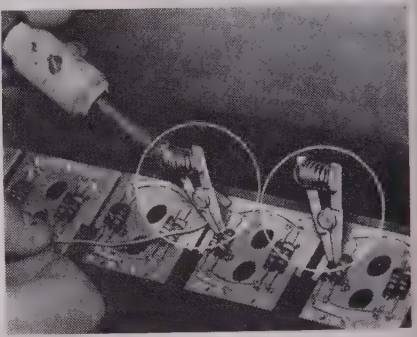
JENNINGS RADIO MFG. CORP., 970 McLAUGHLIN AVE., SAN JOSE 8, CALIF., PHONE CYpress 2-4025

Circle 92 on Inquiry Card

New Products

HEAT SINK CLIP

Designed to protect semiconductors during soldering.

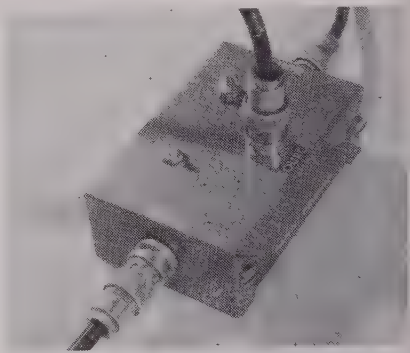


This heat sink clip is made of aluminum. It fits around the wire running between the semiconductor and the joint to be soldered and during the soldering operation absorbs and dissipates the heat that runs up the wire toward the semiconductor. They are easy to use on assembly operations and reduce assembly time and rejects. Avtron Mfg., Inc., 10409 Meech Ave., Cleveland 5, Ohio.

Circle 287 on Inquiry Card

SOLID STATE AMPLIFIERS

Features 15 GΩ input impedance and 1 meg. output impedance.



Solid state ultra high impedance amplifier suitable for use in sonar, ultrasonics, and transducers. Characteristics: Freq. response, 5 CPS to 100 KC within 1 db., 3 CPS to 300 KC within 3 db.; Input impedance, 15 GΩ shunted by 1 to 1.5 pf (plus input terminal capacitance, BNC 1 to 2 pf); Output impedance, 1 meg. shunted by 3 to 10 pf; Input to output impedance 10,000 to 20,000 (both adjustable in wide range to match source and load); Voltage gain, 0.2 to 0.5 depending on impedance levels; Power gain, up to 30 to 35 db.; Output voltage, 0.6 max. (for high linear gain 0.2); Energy requirement for operation 30 mw max. Denro Lab., 2801 15th St., N.W., Washington 9, D. C.

Circle 288 on Inquiry Card

New! Sylvania CT4251

First

Compact Decade Counter Tube in Dome-Shaped T-9 Bulb with 10 Output Cathodes

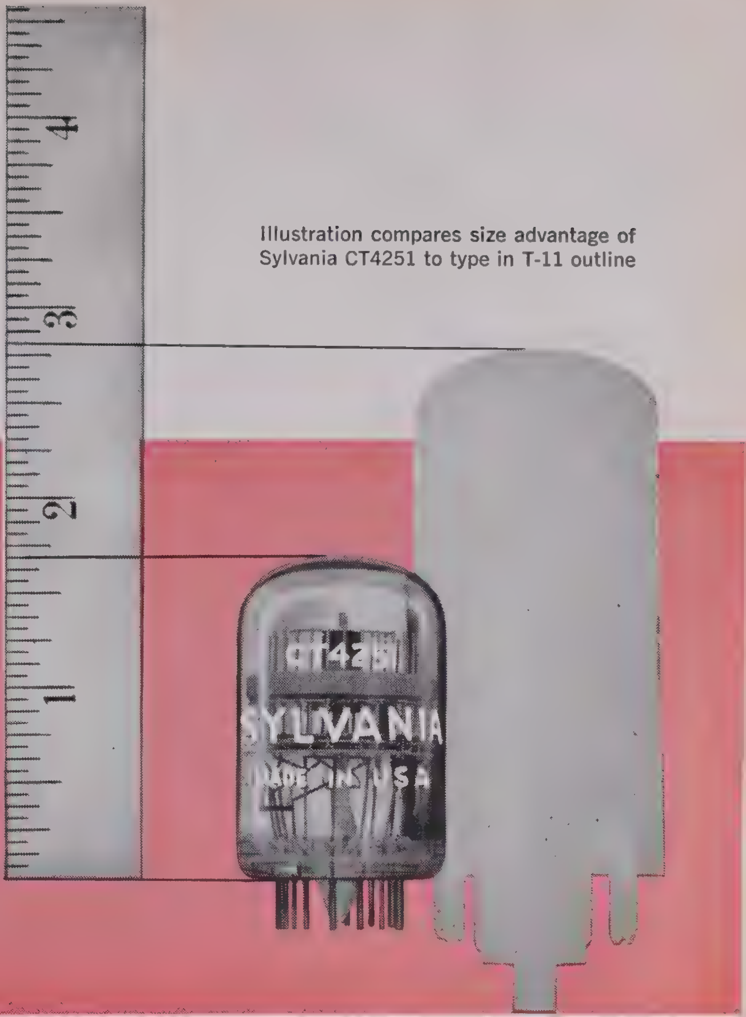


Illustration compares size advantage of Sylvania CT4251 to type in T-11 outline

Sylvania introduces the new CT4251 . . . opening a dramatic new approach to the design of very compact, low-cost counting equipment in the 0-50KC frequency range.

Utilizing a new dome-shaped T-9 bulb evacuated from the base, Sylvania CT4251 offers significant reductions in seated height. CT4251 features 10 output cathodes, offering the versatility and advantages of tube types previously available only in the T-11 bulb. Examples: electrical information can be fed from all 10 cathodes, enabling preselection of a count from 0-9; the diameter of the ring of cathodes is identical with that of types in the T-11 outline, providing excellent visibility of readout information.

Sylvania CT4251 is the lowest cost *cold cathode Decade Counter Tube* available. Combining electrical and visual readout functions, it offers extensive economies in circuitry and associated components. Sockets, too, for its 13-pin circle are as much as one-half the cost of sockets normally required for T-11 types. In addition, this new 13-pin circle makes it possible for Sylvania CT4251 to be designed into equipment using transistorized and printed circuit techniques.

Tests to date of Sylvania CT4251 indicate superior quality performance even under stand-by operation for 500 hours.

Your Sylvania Sales Engineer will be pleased to tell you more. Contact him or write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 198, 1100 Main St., Buffalo 9, N.Y.

Sylvania Type	Total Anode Current (mA)		Min. Anode Supply Voltage (Vdc)	Min. Double Pulse Amplitude (V)	Min. Double Pulse Width (μsec)
	Min.	Max.			
CT4251	0.65	0.8	400	–70	4

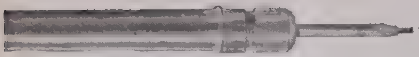
SYLVANIA

SUBSIDIARY OF

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

Another "impossible" job done by the Airbrasive®...



...cutting semiconductors

abrading • cutting • deburring • stripping • drilling • cleaning • scribing

Hughes cuts fancy figures in silicon. Reports "Airbrasive is the only tool capable of handling the process!"

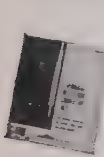
Hughes Aircraft uses the Industrial Airbrasive linked to a pantograph to cut intricate patterns and shapes in semiconductor wafers. And what's more they are doing it accurately and with *complete safety to the fragile part*.

The secret of this unique tool is a superfine jet of abrasive particles and dry gas, directed through a carbide nozzle. The resulting cutting action in hard brittle materials is cool, rapid, precise, and completely shockless.

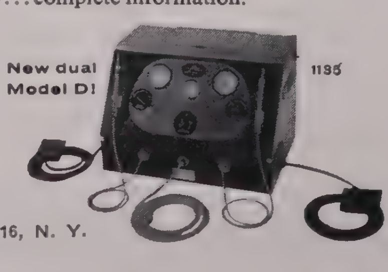
The Airbrasive is being used to solve hundreds of seemingly impossible jobs . . . precision deburring . . . to remove surface deposits . . . form and adjust microminiaturized circuits . . . cut glass, germanium, tungsten, ferrites, and others.

Low in cost too. For under $1,000.00 you can set up your own Airbrasive cutting unit!

Send us samples of your "impossible" jobs and we will test them for you at no cost.



SEND FOR BULLETIN 6006 . . . complete information.



S. S. White

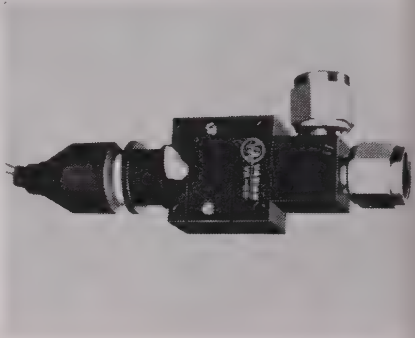
S. S. White Industrial Division
Dept. 19A 10 East 40th Street, New York 16, N. Y.

Circle 94 on Inquiry Card

New Products

OSCILLATOR KLYSTRONS

Low-noise devices for fixed-freq. doppler navigation transmitters.

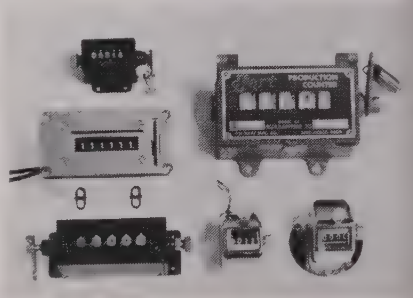


The VA-511 produces 50 w. min. power at 10.0 GC and operates at 10 kv, 60 ma. This fixed-freq., 2-cavity oscillator has an FM noise figure less than 1 CPS, and is electrostatically-focused. Weighs less than 24 oz., measures 6¼ x 2¼ x 1¾ in. Varian Assoc., Tube Div., 611 Hansen Way, Palo Alto, Calif.

Circle 289 on Inquiry Card

COUNTERS AND TALLYS

Rated at 700 strokes per minute and feature outside resets.



Line of light and medium duty counters and tallys include both mechanical and magnetic impulse models. They are factory guaranteed and factory serviced. Counters illustrated are—(c-cw): Model HL-5, for light metal working and office equipment; Model HE-6, an electrical counter for remote control or difficult installations; Model HM-5, a medium duty fast stroke counter for drills, milling machines, automatics, etc.; Model HT-4, a hand tally for inventory; Model HD-4, a desk tally for laboratory use; Model 5A, a heavy duty industrial counter. Hart Mfg. Co., Ann Arbor, Mich.

Circle 290 on Inquiry Card

35,000 SMASHING, BATTERING IMPACTS—

and still working perfectly!

SHURE "TEN-FOUR"

COMMUNICATIONS MICROPHONE

proves its incredible durability in this gruelling destruction test!

New SHURE "TEN-FOUR" MICROPHONE, with exclusive Armo-Dur housing, and another microphone with standard die-cast metal housing were dragged for miles on a test drive over all kinds of pavements at speeds to 30 mph. In a matter of minutes, it was subjected to greater punishment than a lifetime of severest mishandling *and here's the result:*

Ten-Four with Armo-Dur Housing virtually unmarked—*still performed perfectly!*

Standard microphone with die-cast metal housing—cracked, broken, abraded—microphone inoperable.

For the microphone that stands up under severe operating conditions with no loss of high speech intelligibility, be sure to specify the Shure "Ten-Four" when you order your new communications equipment or replacements.

(Can be furnished with "Controlled Magnetic" or carbon cartridge.)

SHURE BROTHERS, INCORPORATED
222 Hartrey Avenue, Evanston, Illinois
HIGHEST QUALITY MICROPHONES—FIXED-STATION AND MOBILE

Circle 127 on Inquiry Card

Try it with

CUT 'N' STRIP Trial Kit

STABILENE Cut 'N' Strip Trial Kit contains: 1. 2 sheets STABILENE Cut 'N' Strip Film (NR136-2). 2. Dual-Purpose Drafting Pencil (holds both lead and cutting blade). 3. Complete Instructions. 4. Brochure: "Preparing Printed Circuits on STABILENE Film."

Have you heard about Cut 'N' Strip – the remarkable new method for preparing printed circuit masters? If not, you're in for a revelation. Cut 'N' Strip is far and away the easiest, and one of the most accurate methods of preparing printed circuit masters. With Cut 'N' Strip, there's no ink to run – no tape to stretch, shrink, pile up, or pull away on curves. What's more, Cut 'N' Strip eliminates many time-consuming photographic steps. In some cases, you can skip *all* intermediate photography.

There are three steps to the average Cut 'N' Strip operation. First, a rough layout is drawn in pencil on the back of a sheet of STABILENE® Cut 'N' Strip Film. Next, the film is turned face up and the lands and runs are cut in the film's transparent (but actinically opaque) surface using a special cutting tool. Finally, portions of the surface coating are peeled away with a knife or tweezers. For a negative, you would peel *inside* the outlines. For a positive, you would peel away everything *but* the circuit paths. For corrections, unwanted lines are simply filled in with K&E Opaquing Fluid, new lines recut, and peeled similar to the original coating.

STABILENE Cut 'N' Strip Film yields sharp outlines for crisp reproduction, and can be exposed directly onto the laminate.

Is this remarkable new printed circuit process for you? We'd like to offer you a really *practical* means of finding out. To do so, we've compiled a complete Cut 'N' Strip Trial Kit containing everything you need to make a few trial masters. Using the kit, you'll be able to see for yourself what Cut 'N' Strip has meant to so many in terms of greater speed, accuracy, and savings. To get your kit, simply fill out and mail the coupon below.

4377

K+E **KEUFFEL & ESSER CO.**

NEW YORK • HOBOKEN, N. J. • PHILADELPHIA • DETROIT • CHICAGO • MILWAUKEE
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KEUFFEL & ESSER CO., Dept. EI-9, Hoboken, N. J.

Please send me a STABILENE Cut 'N' Strip Trial Kit. I enclose 70¢ (coin, check, or money order) to defray cost of materials and handling.

Name & Title: ____________

Company & Address: ____________

Circle 123 on Inquiry Card

Mono Cord

NO SPLICE RINGS

are better because the principle hazard found in ordinary seal rings and belts has been removed by Western's *Mono Cord* one-piece construction. In addition, dimensional requirements are maintained, quality controlled, and service vastly improved—all at no extra cost.

Don't use a spliced ring for technical seal applications, but profit from nearly 60 years experience—specify *Mono Cord* rings by Western.

Write or phone for information, literature or a visit by our sales engineer in your area.

Mono Cord NO SPLICE RINGS R

SINCE W 1902

WESTERN RUBBER CO.
GOSHEN 9, INDIANA

Molded and Lathe-Cut Rubber Parts for All Industries

Circle 96 on Inquiry Card

Wassco® GLO-MELT

RESISTANCE SOLDERING

. . . for Perfect lead-to-pin joints on All sizes of A/N and similar connections

Wassco® GLO-MELT

. . . for Fast-Efficient Accurate-Permanent connections.

209-B

POWER UNITS • HANDPIECES • ACCESSORIES
for all jobs from Micro-Miniature to Heavy-Current connectors

WRITE FOR DESCRIPTIVE LITERATURE, PRICES AND NEAREST DISTRIBUTOR

Wassco® GLO-MELT DIVISION
AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICHIGAN

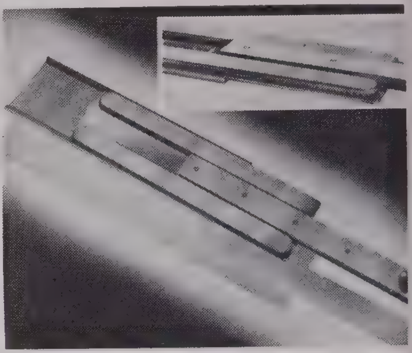
American Beauty ELECTRIC IRONS SINCE 1894

Circle 97 on Inquiry Card

New Products

CIRCULATING BALL SLIDE

Model CBV features a vertical race and thin size.



This permits substantial reduction in overall slide width allowing standard chassis to be used. Model CBV is a heavy-duty slide with a load capacity of 500 lbs. Weight distribution characteristics suit it for use where shock and vibration are likely to occur. Standard sizes range from 16 to 24 in. Entire slide is coated with Poxylube, a bonded film of molybdenum disulfide which permits permanent dry lubrication. Chassis-Trak, Inc., 525 S. Webster Ave., Indianapolis 19, Ind.

Circle 291 on Inquiry Card

WIRE WRAP CONNECTOR

Can be used with both single or double sided 3/32 in. P.C. boards.

"Reli-Acon" card receptacle FD-900 series is designed to meet all data processing and the most stringent ground support military applications. Contract terminals are of the wire wrap type to provide rapid, dependable mechanical connections. The standard part is furnished with a glass reinforced molded dielectric and gold plated beryllium copper contacts, employing 0.028 x 0.062 gold plated brass terminals to produce a reliable connection for up to 4 #20 wires consisting of 5 wraps each. Methode Electronics, Inc., 7447 W. Wilson Ave., Chicago 31, Ill.

Circle 292 on Inquiry Card

MICROCIRCUITRY AVAILABLE IN QUANTITY

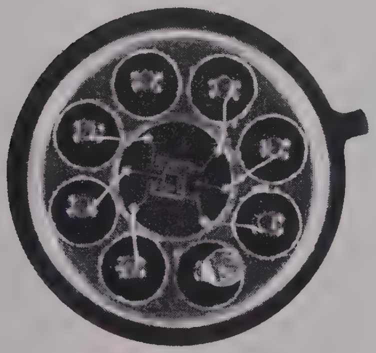
THREE NEW FAIRCHILD MICROLOGIC COMPUTER ELEMENTS Available for immediate volume delivery are the Flip-flop, the Gate, and the Half-shift Register. These high-speed, low-power devices operate at bit rates in excess of 1 mc. For the first time complete arithmetic and control sections can be produced with SILICON PLANAR, SINGLE CHIP logic building blocks.

DESIGN AND ASSEMBLY COST REDUCTIONS—UP TO 90% Fairchild Micrologic elements can reduce system design and assembly costs up to 90%, space requirements up to 95%, and power needs up to 75%, thus making many new computer applications practical and economically feasible. They can be used over the full military temperature range (—55° C. to +125° C.).

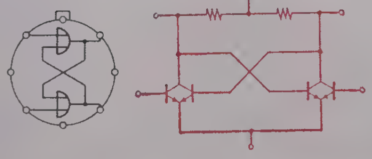
RELIABILITY—500,000 HOURS AT 125°C
The equivalent of 3,000,000 component operating hours without a single failure. A new order of stability and reliability is made possible by the Fairchild Planar process with total protection of the passivated oxide surface.

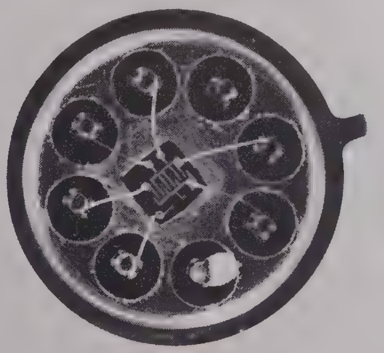
SILICON PLANAR SINGLE CHIP CIRCUITS

UNRETOUCHED PHOTOGRAPHS MAGNIFIED 5 TIMES

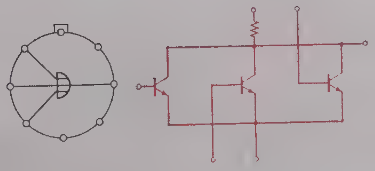


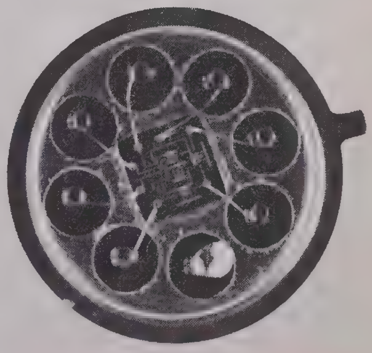
"F" FLIP-FLOP
TO-5 size header



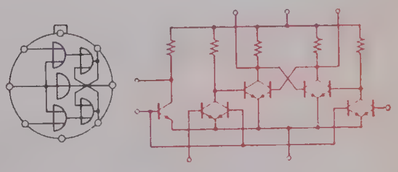


"G" GATE
TO-5 size header





"S" HALF-SHIFT REGISTER
TO-5 size header



NOR DIAGRAMS AND CIRCUITS FOR EQUIVALENT FUNCTIONS

For complete data, specifications and pricing information contact your Fairchild Field Sales Office. Or write direct. Three additional elements (the Half-adder, Buffer and Counter Adapter) will be available soon to complete the Fairchild Micrologic family.

μL and μLogic are trademarks of Fairchild Semiconductor, a Division of Fairchild Camera and Instrument Corporation

FAIRCHILD
SEMICONDUCTOR
545 WHISMAN ROAD, MOUNTAIN VIEW, CALIF. • YORKSHIRE 8-8161 • TWX: MN VW CAL 853
A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

Circle 85 on Inquiry Card

FAULT INDICATOR

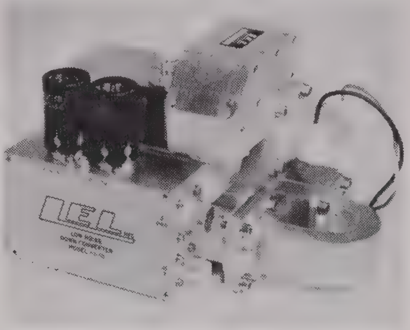
Available in a wide variety of current and voltage ranges.

The ¾ in. sealed miniature magnetic latch-in device has a disc type flag, which may be color coded or imprinted to designate the function being monitored. When energized, it rotates to the "on" position and is held there magnetically even if the energizing source is removed. The device maintains positive indication even when unenergized under vibration from 10 to 500 CPS at 10G. Minneapolis-Honeywell, Precision Meter Div., Grenier Field, Manchester, N. H.

Circle 308 on Inquiry Card

PARAMETRIC AMPLIFIER

Combination of up-converter amplifier and low noise down-converter.

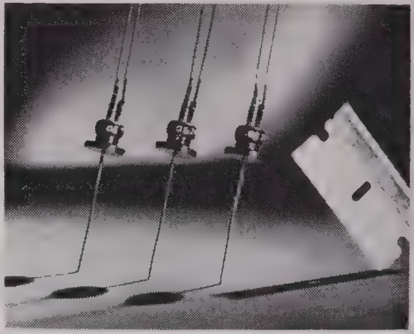


Model RA-1b has a single Klystron serving the dual function of up-converter pump and down-converter local oscillator, thus cancelling freq. drift. The standard model is designed for 225-260 MC operation, but may be modified for operation up to 1 GC. Its small size and light weight make airborne and missile applications practical. Specs: Gain, 25 db.; Passband, 225-260 MC; Noise figure, 1.0 to 2.0 db.; Weight, 6 lbs. LEL, Inc., 75 Akron St., Copiague, N. Y.

Circle 309 on Inquiry Card

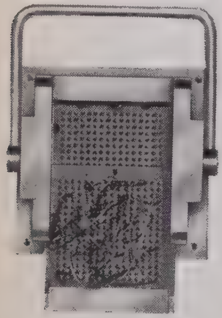
RECTIFIER LINE

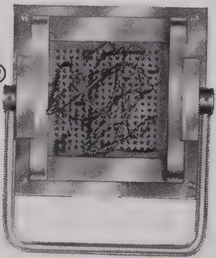
For use in pulse modulators, indicators and counters.



Low current silicon controlled rectifiers in double-ended housing have the stud replaced by a single lead. Units will accommodate high current loads without heat sinks. The 7 models have JEDEC designations 2N1929 through 2N1935. They differ by repetitive peak reverse voltage ratings ranging from 25 v. for the 2N1929 to 300 v. for the 2N1935. The dc load current rating is 1.1 a. General Electric Co., Rectifier Components Dept., W. Genesee St., Auburn, N. Y.

Circle 310 on Inquiry Card





Cambion® quick-change patch panel

...cuts programing down-time

Reduce the down-time of computer program changes with the new CAMBION "256" high density *quick-change* patch panel. Miniature 4″ x 4″ circuit boards can be set up in advance then changed instantly in the panel. Simply throw lever open . . . change boards . . . close the lever.

The 256 plugs and jacks are precision machined brass (per QQ-B-626a) with heavy gold plate over copper plate. Connections have been conservatively rated at 1 amp. and life-tested for more than 50,000 insertions. For complete details and your copy of the new CAMBION Plug and Jack Catalog, write CAMBRIDGE THERMIONIC CORPORATION, 504 Concord Ave., Cambridge 38, Mass.

CAMBRIDGE THERMIONIC CORPORATION
CAMBION®
The guaranteed electronic components

Circle 131 on Inquiry Card

NEW SYMBOL OF RELIABILITY

in
REFERENCE UNITS .0005%/°c
Silicon Diodes
Regulators
Solar Cells
Rectifiers

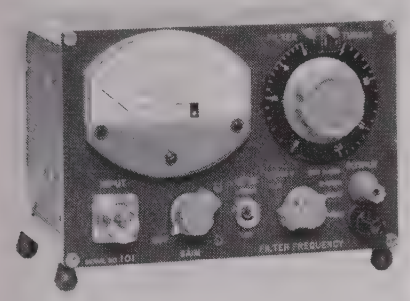
AMERICAN
SEMICONDUCTOR CORPORATION
3940 N. Kilpatrick Ave. • Chicago 41, Ill.

Circle 132 on Inquiry Card

New Products

BRIDGE DETECTOR

May be used as a tuned audio amplifier.

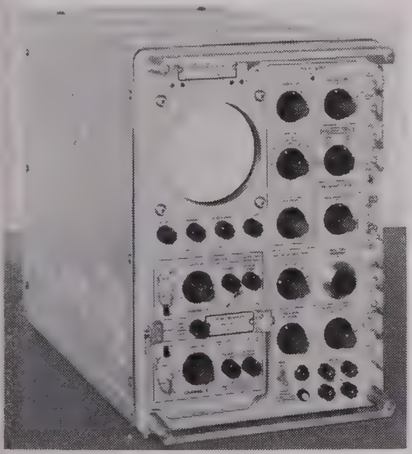


Tuned amplifier and null detector, Type 1232-A, measures 8 x 6 x 7¾ in. In addition to its main use as a bridge detector, it has applications as a preamplifier and an audio spectrum analyzer. Completely transistorized and battery-operated, the unit is housed in a G-R rack bench cabinet. Filter freq. range from flat to 100 KC. Controls include linear/log meter switch. General Radio Co., West Concord, Mass.

Circle 293 on Inquiry Card

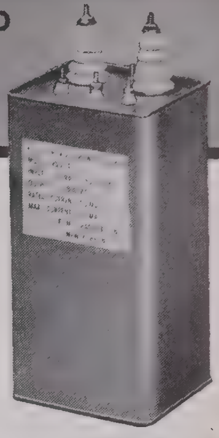
OSCILLOSCOPE

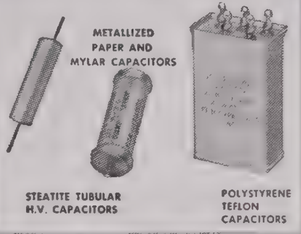
For precise measurements, dc to 24 MC, *under severe environments.*



Environmentalized oscilloscope has sweep-delay feature with Type MC Dual-Trace Preamp. plugged into the vertical channel. Type 945 oscilloscope features: Temp., —40°C to 55°C/71°C, (operating) —65°C to +85°C (storage); Humidity, 10 days, 95% RH 18°C to 65°C (storage); Fungus, 28 days (storage); Vibration, 5 G's, 55 CPS, 0.030 in. pk-pk (operating); Radio interference, 15 KC to 400 MC (operating); and salt atmosphere, 100 hrs. (finishes). Tektronix, Inc., P. O. Box 500, Beaverton, Ore.

Circle 294 on Inquiry Card





fci OIL FILLED • HERMETICALLY-SEALED
SOLID STATE • MINIATURIZED

Power Supplies

Electrical Characteristics

PART NO.	OUTPUT VOLTAGE	% RIPPLE AT RATED CURRENT	RATED CURRENT OUTPUT	MAX. CURRENT OUTPUT
PS-2S	2 KVDC	1%	5 MA	7.5 MA
PS-5S	5 KVDC	1%	5 MA	7.5 MA
PS-12S	12 KVDC	1.5%	1 MA	1.75 MA
PS-15S	15 KVDC	1.5%	1 MA	1.75 MA
PS-30S	30 KVDC	1.5%	1 MA	1.75 MA
PS-50S	50 KVDC	1.5%	1 MA	1.75 MA

- All models are designed with a full wave doubler circuit.
- Voltages on all models can be varied from zero to maximum.
- Safety-rated components assure long trouble-free life.
- Neutral case may be positive, negative, or left floating.

WRITE FOR FURTHER INFORMATION
AND OUR COMPLETE CATALOG

ALSO MANUFACTURERS OF:

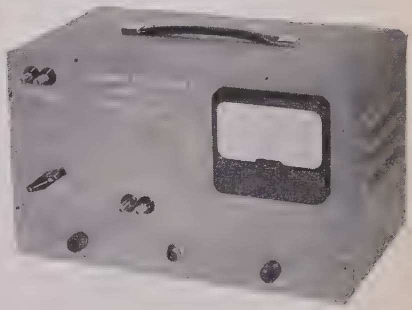
METALLIZED PAPER AND MYLAR CAPACITORS

STEATITE TUBULAR H.V. CAPACITORS

POLYSTYRENE TEFLON CAPACITORS

Film Capacitors, Inc. 3400-06 PARK AVENUE, NEW YORK 56

Circle 101 on Inquiry Card



IMPEDANCE COMPARATORS

PRECISE, RELIABLE AND RAPID COMPARISON OF COMPONENTS

- Tests resistors, condensers, Inductors
- Percentage deviation from standard read on large meter
- Rapid response — no buttons to push
- High accuracy and stability
- Self calibrating — requires no recalibration when changing ranges

SPECIFICATIONS	MODEL 60	MODEL 1010
BRIDGE SUPPLY	6 Volts	2 Volts
FREQUENCY	60 CPS	Either 1 KC or 10 KC
FULL SCALE RANGES	±1%, ±5%, ±10, ±20%	±5%, ±10%, ±20%
IMPEDANCE LIMITS:		
Resistance	5 ohms to 5 megohms	5 ohms to 5 megohms
Capacitance	500 mmfd. to 500 mfd.	50 mmfd. to 10 mfd.
Inductance	15 millihy. to 10,000 hy.	100 microhy. to 100 hy.
PRICE	$199.00	$329.00

OTHER MODELS AVAILABLE

MODEL	BRIDGE VOLTS	FULL SCALE RANGES
1000	2.5V-1000 CPS	±1, 5, 10%
1025	2V-1 KC, 25 KC	±5, 10, 20%
400	2.5V-400 CPS	±1, 10, 20%
60-S	.2V-60 CPS	±1, 2, 10, 20%
60-L	.6V-60 CPS	±1, 5, 10, 20%

Representatives in Principal Cities

ITECO INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th STREET • NEW YORK 3, N. Y.

Visit BOOTH #213, NEC SHOW, International Amphitheatre, Chicago, Oct. 9-11, 1961

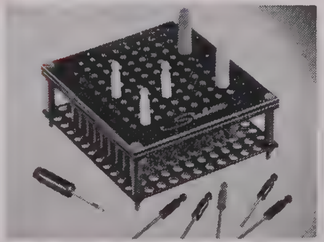
Circle 102 on Inquiry Card

The terminal that revolutionized the industry, showing the way to faster, better, more dependable terminations compatible with the most critical requirements, is just as close as your local Sealectro distributor. He carries a wide choice of terminals, feedthroughs, test jacks, probes, stand-offs and countless other Press-Fit components.

CON HEX® SUB-MINIATURE R.F. CONNECTORS

Your Sealectro distributor has them in stock—the superior sub-miniature r.f. connector, precisely made to assure optimum electrical and mechanical performance. Now available in Snap-On and Screw-On types in either Clamp-On cable connecting or the time-saving, cost-cutting new Crimp-On type.

SEALECTOBOARD PROTO-KIT



Brand-new, and better too! Complete programming systems that eliminate patch cords. Provide component interpositioning by merely pushing in a pin. The Sealectoboard concept is currently being used in many of the most critical electronic systems. Get a Proto-Kit from your Sealectro distributor today— it has 1001 uses!

* *Write for catalogs and listings of distributors...*

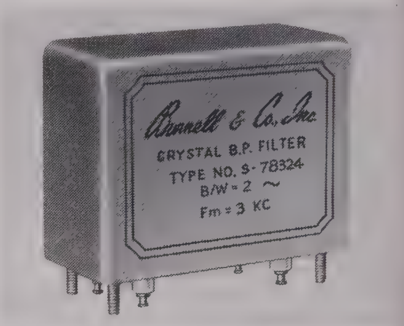
Sealectro CORPORATION
139 HOYT STREET • MAMARONECK, N. Y.
British Branch: Surrey, England.

Circle 103 on Inquiry Card

New Products

SMALL CRYSTAL FILTER

3 kc units for missile, communication and control use.

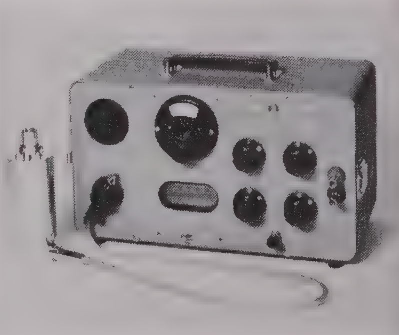


Specs include: Insertion loss, 3.5 db; Attenuation, 3 db bandwidth, 2 CPS; Shape factor, 30/3, 5:1; Temp. coefficient, 0.021 CPS/°C; Input impedance, 500 KΩ; Output impedance, 500 KΩ. The low freq. crystal filter meets Mil-C-3908B for vibration standards as well as applicable portions of Mil-T-27A. Other crystal filters available from 1 KC to 30 MC in a wide range of impedances. Burnell & Co., 10 Pelham Pkwy., Pelham, N. Y.

Circle 295 on Inquiry Card

HF TRANSFER VOLTMETER

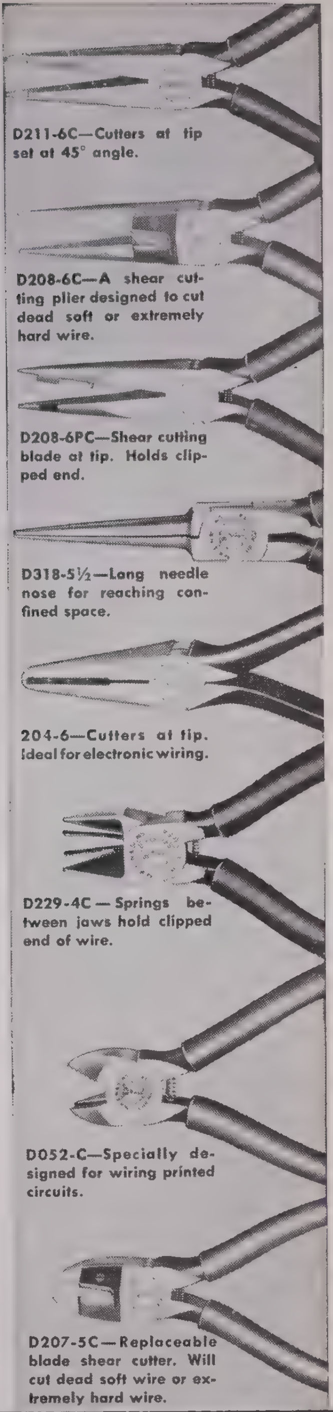
Probe transfer impedance is uniform from 25 CPS to 30 MC.



Model 393 is a transfer device by means of which an unknown ac voltage may be measured with high accuracy in terms of a dc voltage. Its primary uses will be in standards laboratories for calibration of r-f signal sources, r-f voltmeters, and the freq. response of amplifiers or other devices. Accuracy of transfer 0.1% 25 CPS to 10 MC, and 0.5% 10 MC to 30 MC. Ballantine Laboratories, Inc., Boonton, N. J.

Circle 296 on Inquiry Card

Special Pliers for the Highly Specialized Electronics Field



D211-6C—Cutters at tip set at 45° angle.

D208-6C—A shear cutting plier designed to cut dead soft or extremely hard wire.

D208-6PC—Shear cutting blade at tip. Holds clipped end.

D318-5½—Long needle nose for reaching confined space.

204-6—Cutters at tip. Ideal for electronic wiring.

D229-4C — Springs between jaws hold clipped end of wire.

D052-C—Specially designed for wiring printed circuits.

D207-5C—Replaceable blade shear cutter. Will cut dead soft wire or extremely hard wire.

When the early transmission lines were strung in this country a century ago, it was Klein Pliers in the hands of linemen that helped do the job.

Klein has kept pace with the development of the electrical field, meeting each new challenge with tools specially designed to do the wiring job better . . . more economically.

Shown here are a few of the many highly specialized Klein Pliers carried in stock to meet the needs of electrical and electronics manufacturers.

You will find your assemblies go together more smoothly and wiring is done more rapidly when the right Klein Plier is used.

SEE YOUR DISTRIBUTOR

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Established 1857
Chicago, Ill., U.S.A
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Please send me the Klein Plier Catalog and information.

Name____________________

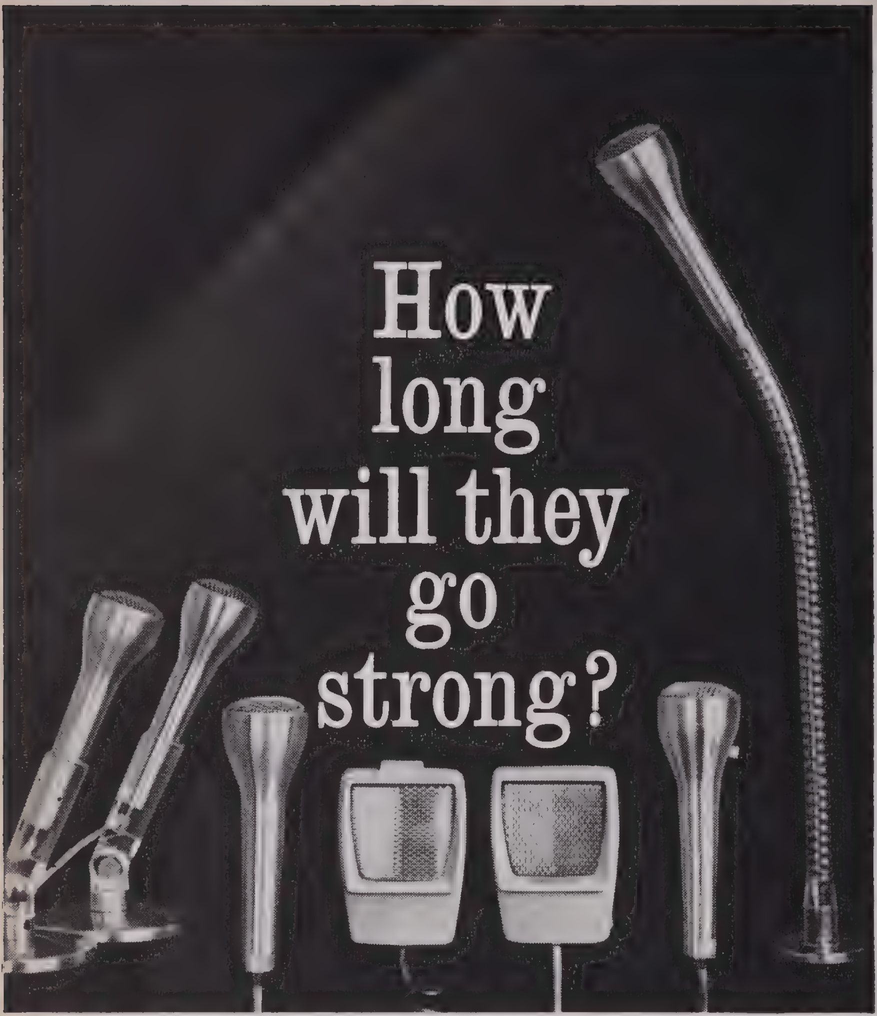
Title____________________

Company____________________

Address____________________

City____________________ State__________

Circle 104 on Inquiry Card



Years! Any Sonotone "Ceramike®" stands up to all kinds of mistreatment...yet stays "fidelity" itself.

Until a few years ago, mikes were variable. If they were "hi-fi," chances were they were delicate. If they were sturdy, they didn't reproduce as well as they could. Then came the Sonotone "Ceramike" series.

All "Ceramikes" are shock-proof, impact-proof, shatter-proof, heat-proof and "bad-treatment"-proof. They will work even if you immerse them in water. The ceramic transducer at the heart is immune to changes of temperature and humidity. Extensive factory tests insure you that every "Ceramike" will keep on performing at its peak no matter what!

And fidelity? Look below, for specifications that would do anybody proud. Sell trouble-free, dependable performance and an installation that lasts for years. Be sure and stock the full line of "Ceramikes".

Specifications for Complete "Ceramike" Line

CM-10A—For tape recorders, etc.
Frequency response ....50 to 11,000 cps
Sensitivity....................—56 decibels ±2db
CM-11A—Where greater sensitivity is desired
Frequency response ....80 to 9,000 cps
Sensitivity....................—53 decibels ±2db
CM-T10A—For stereo taping
Frequency response ....50 to 11,000 cps
Sensitivity....................—56 decibels ±2db
CM-T11A—For stereo taping, also greater sensitivity
Frequency response ....80 to 9,000 cps
Sensitivity....................—53 decibels ±2db
CM-12A—For long lead installations—PA systems, etc. with push-to-talk switch
Frequency response ....200 to 8,000 cps
Sensitivity..................—63.5 decibels ±2db
CM-17A—"Flex-Mike". For audio-visual labs, etc.
Frequency response ....50 to 11,000 cps
Sensitivity....................—56 decibels ±2db
CM-30—Coiled Cord, Switch. For citizen's band use—
Frequency response ....100 to 6,000 cps
Sensitivity....................—49 decibels ±2db
CM-31—Coiled Cord. For communication use—
Frequency response ....100 to 6,000 cps
Sensitivity....................—49 decibels ±2db
CM-32—Standard Cord & Plug. For tape recordings—
Frequency response ....80 to 9,000 cps
Sensitivity....................—49 decibels ±2db

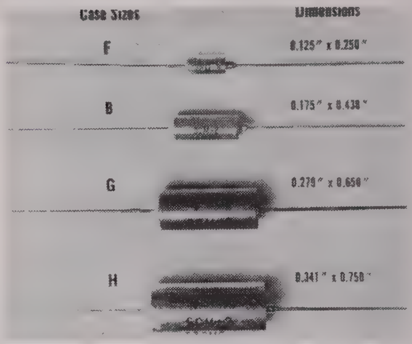
Sonotone® CORP.
ELECTRONIC APPLICATIONS DIVISION
DEPT. P21-91, ELMSFORD, N. Y.
In Canada, contact Atlas Radio Corp., Ltd., Toronto

Leading Makers of Cartridges • Speakers • Tape Heads • Mikes • Electronic Tubes • Batteries

New Products

TANTALUM CAPACITORS

Added to tan-TI-cap® line: 28 new ratings—0.0047 to 0.82 µf.



Packaged in Type SCM "F" case, 0.125 x 0.250 in., these reliable miniature solid tantalum capacitors are available in 20 v. or 35 vdc voltage ratings. Offered in ±10% and ±20% tolerances and 10% decade ratings. Will meet mechanical and electrical requirements of Mil-C-26655A. For use in computers, airborne communication, and microwave and common carrier systems. Texas Instruments Incorporated, P. O. Box 5012, Dallas 22, Tex.

Circle 297 on Inquiry Card

TRANSISTORIZED CHOPPER

Can be driven from 115 v. RMS, 60 or 400 CPS line.

Model 64 Plug-in Line Driven-Chopper (or modulator), has a transformer-coupled isolating drive network and clipping diodes so that it can be driven from a 400 CPS sine wave power line or from a drive source common to the dc voltage being chopped. Sinusoidal or square wave drive may be used over a freq. range 70 CPS to 10 KC sine wave, or 40 CPS to 12 KC square wave. Operating temp. —55°C to +90°C. Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

Circle 298 on Inquiry Card

New Products

EPOXY MOLDING COMPOUNDS

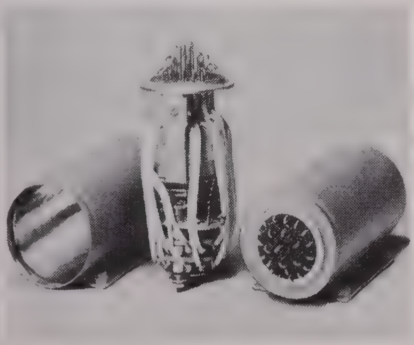
Cure in a min. of 15 sec. for high speed and volume molding production.

A dry granular material, the EMC 90 series is nonburning and offers a storage life of 1 year or longer at room temps. Developed for component encapsulation and structural uses, it permits high flow at low temp. and pressures while providing good mold release and complete rigidity of parts upon ejection from the mold. Available in blue or black. American-Marietta Co., Adhesive Resin & Chemical Div., 3400 13th Ave., S.W., Seattle 4, Wash.

Circle 281 on Inquiry Card

SOLENOID SELECTOR

Miniaturized assembly for use in severe environments.

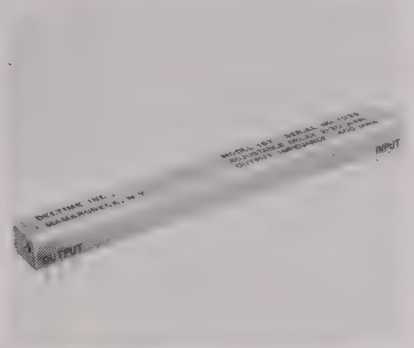


It is hermetically sealed, (per Mil-S-8484), miniaturized, giving protection against sand, dust, salt spray, explosion, humidity, altitude and fungus. The assembly is available with 28-pin plug-in or 28 pin hook type header for soldering leads. It consists of a 12-position rotary switch coupled to a rotary solenoid. Temp. range is −65°C to +85°C with intermittent duty cycle. Operating voltage, 24-28 vdc, size 3¼ x 1½ x 1 19/32 in. seated height. Oak Mfg. Co., Crystal Lake, Ill.

Circle 282 on Inquiry Card

DELAY LINE

Magnetostrictive unit has continuously variable output 2 to 20 μsec.

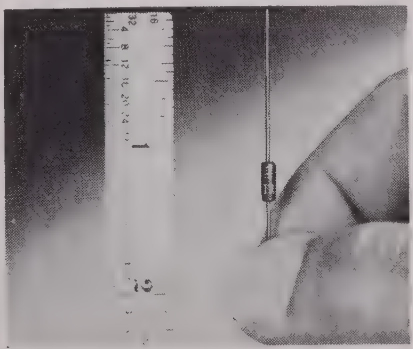


Suited to laboratory work as well as a component for systems in which delay time must be adjusted to the initial "trimming" of the system, or in which operation characteristics are subject to change. Delay time is adjusted by means of a single multi-turn screw. Pulse repetition rate is 500 KC max., input pulse width is 1.0 μsec. Insertion is approx. 45 db. Input and output impedances are 400 Ω. Deltime Inc., 608 Fayette Ave., Mamaroneck, N. Y.

Circle 283 on Inquiry Card

GLASS ZENER DIODES

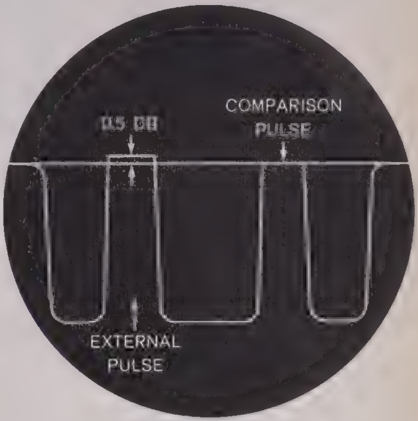
38 JEDEC types provide 3.9 to 33 v. @ 250 mw power dissipation.



Two series of subminiature glass zener diodes provide sharp zener "knees," and good voltage regulation over temp. range −55 to +150°C. Types 1N1313-1320 span the voltage range from 8.2 to 33 v.; types 1N1927-1937 range from 3.9 to 27 v. Both series are available in production quantities in both 5% and 10% voltage tolerance. They possess low temp. coefficients (to 0.060%/°C) and low impedance values (to 8 Ω @ 10 ma). International Rectifier Corp., 233 Kansas St., El Segundo, Calif.

Circle 284 on Inquiry Card

DETERMINE
PEAK
PULSE POWER
WITHIN 0.5 DB



WITH
MULTI-BAND
FLEXIBILITY

The Series 5000 Pulse Power Calibrator is the only instrument that will give a final, direct reading of peak rf pulse power to this degree of accuracy . . . quickly, regardless of waveshape, and without introducing unknown errors. In addition, it provides multiple-band coverage, through the use of interchangeable rf heads.

RF Unit Model 5205, now available, covers the range from 8500 to 9600 mc. Other rf heads, in development, will cover further important bands. The display, essentially a notch wattmeter, permits comparative power discrimination within less than 0.1 db. Direct input power level range is approximately −5 to +63 dbm.

WRITE TODAY for more information on this and other new GCC developments in microwave components, wavemeters, attenuators, oscillators and test equipment.

GENERAL COMMUNICATION COMPANY
677 Beacon Street
Boston, Mass.

Circle 142 on Inquiry Card

Extra quality at no extra cost with Bendix Semiconductors

Bendix Bulletin

HOW TO GET IMPROVED PERFORMANCE IN SWITCHING CIRCUITS

Bendix 2N1008 medium-power, medium-speed series solving design problems on wide front

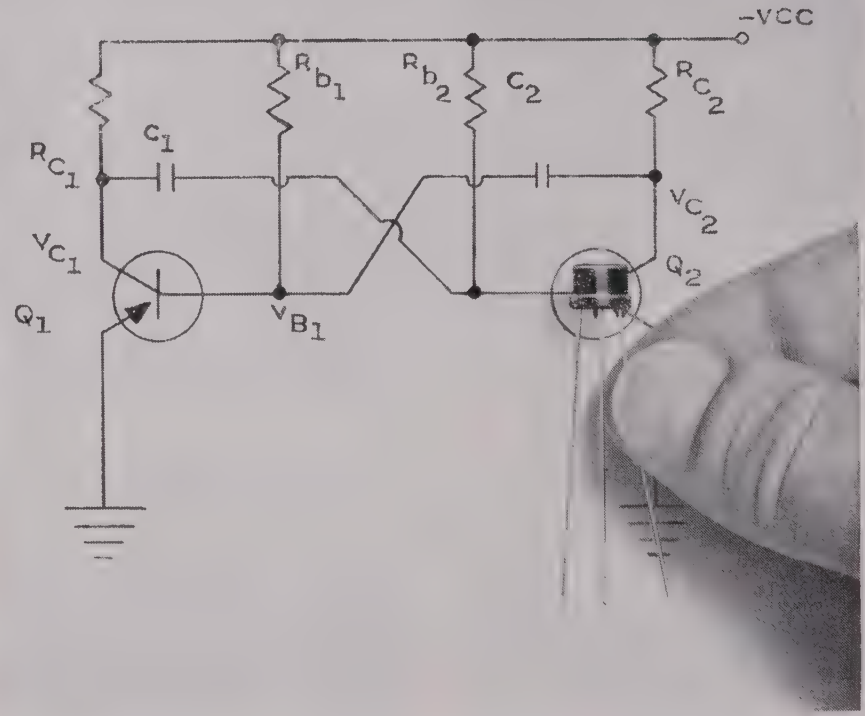
Called the "workhorse of the transistor industry," the new Bendix* Driver Transistor series is winning the nod from more and more engineers daily. These men find it the answer to audio frequency and switching applications requiring extra performance.

The Bendix units combine higher voltage rating and high current gain with more linear current gain characteristics for low distortion and more efficient switching.

It is this kind of *extra* quality—combined with exceptional dependability and versatility—that's making these special Bendix devices the choice of more and more design engineers every day in answering audio frequency and switching application needs. Further advantages: Cost is low, and delivery in JEDEC TO-5 packages is *fast*.

For full details, write BENDIX SEMICONDUCTOR PRODUCTS, HOLMDEL, NEW JERSEY.

*TRADEMARK



Typical Bendix 2N1008-equipped multivibrator circuit used in digital computers as a frequency divider, and in other medium-speed triggering applications.

APPLICATION, PERFORMANCE DATA INDICATE BROAD USAGE

TYPE NUMBERS	MAXIMUM RATINGS					TYPICAL OPERATION		
	Vce	Ic	Pc	Tj	T storage	hfe	fαb	Vce (Sat)
	Vdc	mAdc	mW	°C	°C	Ic = 10 mAdc		Ic = 100 mAdc Ib = 10 mAdc
2N1008	−20	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1008A	−40	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1008B	−60	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1176	−15	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc
2N1176A	−40	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc
2N1176B	−60	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc

Ideal for such applications as:

TRANSISTOR DRIVER • AUDIO AMPLIFIER (CLASS A OR B)
POWER SUPPLY • SERVO CONTROL • AUDIO OSCILLATOR
MOTOR CONTROL • RELAY DRIVER • POWER SWITCH

BENDIX SEMICONDUCTOR DIVISION

HOLMDEL, NEW JERSEY

THE Bendix CORPORATION

Main Office: South Street, Holmdel, N. J.—Ph: SH 7-5400 • New England Office: 114 Waltham, Lexington, Mass.—Ph: VO 2-7650 • Detroit Office: 12950 West 8 Mile Road, Detroit 37, Mich.—Ph: JO 6-1420 • Midwest Office: 2N565 York Rd., Elmhurst, Ill.—Ph: BR 9-5050 • West Coast Office: 117 E. Providencia Ave., Burbank, Calif.—Ph: VI 9-3961 • Canadian Affiliate: Computing Devices of Canada, P.O. Box 508, Ottawa 4, Ont. • Export Office: Bendix International, 205 E. 42nd Street, New York 17, N.Y.

Bendix

SEMICONDUCTORS NOW AVAILABLE FROM DISTRIBUTOR STOCK IN QUANTITIES UP TO

FACTORY PRICES APPLY!

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331 Luckie St., N.W.—JAckson 4-8477

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3101 Fourth Ave.—FAirfax 2-0588

BOSTON, MASS.
Cramer Electronics
811 Boylston St.—COpley 7-4700

BUFFALO, N. Y.
Summit Distributors
916 Main St.—TT 4-3450

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Newark Electronics
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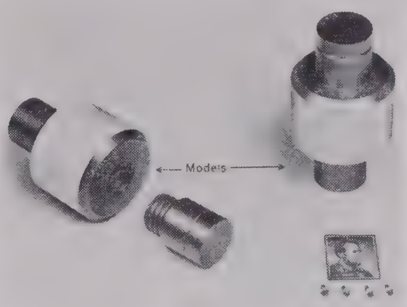

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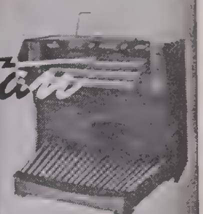

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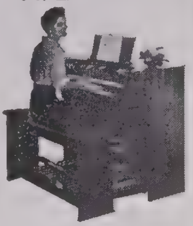

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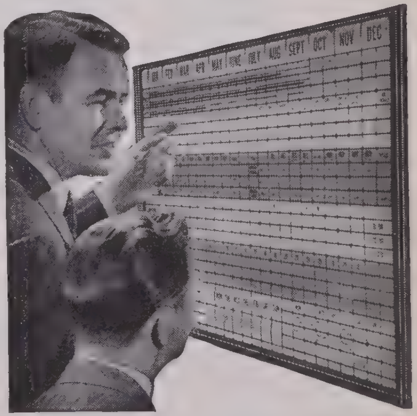
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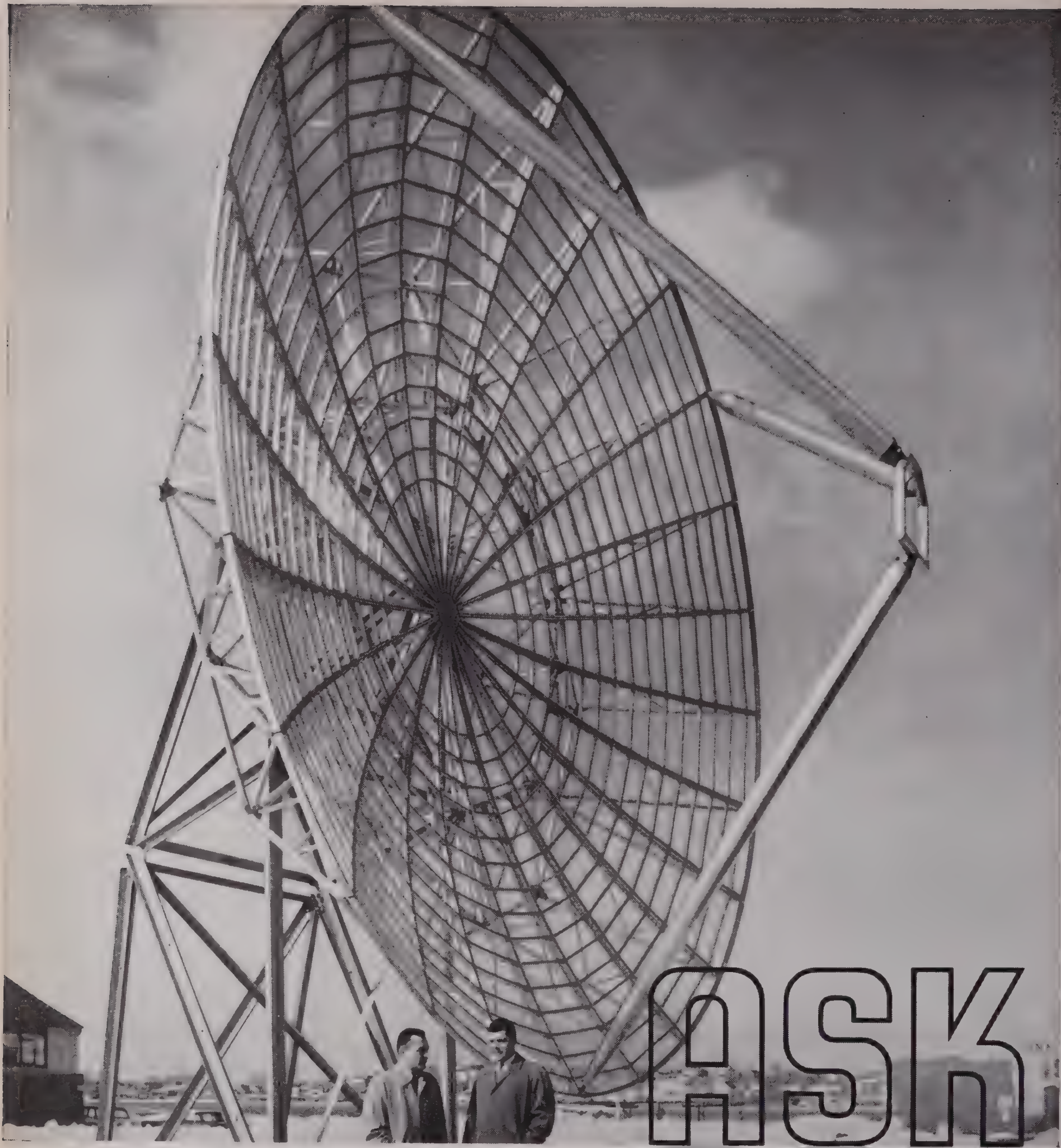

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ANTENNAS, PROPAGATION

The Determination of Optimal Shape of the Plate Ferrite Aerial, Z. Slomczynska. "Prace ITR." Vol. 5, #1. 35 pp. The paper deals with the general properties of ferromagnetic materials, used for aerial cores. Basic relations referring to ferrite aerials are given. The influence of core length, shape and cross-section on plate ferrite aerial properties is treated in detail. (Poland.)

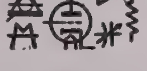
Gain Limit and Tolerances of Big Reflector Antennas, A. Consortini, et al. "Alta Freq." March 1961. 12 pp. The effects of manufacturing errors on antenna gain are studied. The case of a parabolic reflector antenna is considered. (Italy, in English.)

Antenna Diversity Cost and Application, R. Heidester. "El. Rund." April 1961. 3 pp. Various forms of diversity reception are briefly discussed and the basic features of antenna diversity are described. (Germany.)

A Design Chart for Aerials with Parabolic Reflectors, C. O. Titley. "Elec. Eng." March 1961. 2 pp. The chart presented here was produced as an aid to design work on reflectors for radio aerials. (England.)

Canada's Top-side Sounder Satellite Will Probe Ionosphere Next Year, Richard J. Gwyn. "Can. Elec. Eng." May 1961. 2 pp. Defence Research Board scientists, in collaboration with the National Research Council and the U. S. National Aeronautics and Space Administration, have developed a Canadian satellite that will be used for ionosphere top-side soundings in 1962. The special self-extending antennas will be tested aboard a U. S. rocket later this year. (Canada.)

Supergain Antennas, Th. Heller. "Nach. Z." March 1961. 6 pp. The supergain principle states that it is theoretically possible to obtain a gain of any magnitude with an antenna of any small dimensions provided no limits are given for the number of the individual radiators forming the antenna system. (Germany.)



CIRCUITS

Code Storing Subscriber Trunk Dialing Networks, K. Stunk. "Nach. Z." March 1961. 6 pp. After a summary of proven and possible designs of pulse repeaters a solution is given for a storage by means of multistable magnetic cores. In addition to fundamental problems the features of the circuit are described. A new method of saturation indication used for the first time in this case is described in detail. (Germany.)

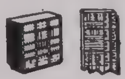
Nyquist Diagram Tracer for A.F.—Circuit and Performance Details, Arthur R. Bailey. "El. Tech." May 1961. The instrument described in this article enables the shape of the Nyquist diagram of a circuit to be determined in a very short time. (England.)

Electrical Circuit for a Transformer with Tabular Windings, K. Schonbacher. "Freq." April 1961. 7 pp. The objective of the study is an accurate circuit diagram in the form of a π- or T-network (a) for the case of very high frequencies and single-layer winding with thick conductors and (b) for windings of fine wire. (Germany.)

Klystron AFC Circuit Stability, L. A. Birger. "Radiotek" 16, No. 3, 1961. 7 pp. Stability conditions are calculated for the AFC circuit of a klystron with frequency conversions which contains a large number of inertial stages in the feedback circuit. (U.S.S.R.)

Sensitivity of Measuring Circuits with Direct Gain in the Super High-Frequency Band, K. I. Palatoff. "Radiotek" 16, No. 3, 1961. 6 pp. An evaluation is made of circuits with direct amplification in the super high-frequency range considering the influence of noise factors and the amplification of the high-frequency unit, detector quatrature, high frequency and video frequency passbands, duration and repetition rate of pulse signals and other parameters. (U.S.S.R.)

Parametric Amplifiers, D. Gossel. "El Rund." March 1961. 5 pp. The principle of energy supply by periodic variation of a circular parameter (reactance) is explained on the basis of an electro-mechanical model. (Germany.)



COMPUTERS

A Versatile Forcing Function Generator, J. Morrison, "Elec. Eng." March 1961. 5 pp. This article describes a forcing function generator designed for analogue computer use which will provide sine, square, triangular, ramp, step or impulse functions to an accuracy of 0.25% full scale in frequency and amplitude. (England.)

Digital Computing Device for Programming Second Order Curves, Yan Si-Zen. "Avto. i Tel." March 1961. 9 pp. An algorithm and structural scheme of a specialized digital computing device as applied to a machine tool for treatment of profiles which consist of straight-line pieces and of second-order curves. (U.S.S.R.)

Versatile Feedback Amplifier for Computers, Laboratories and Industrial Use. "Elec. Eng." May 1961. 5 pp. The experimental work on electronic amplifiers carried out in connection with the design and construction of the E.R.A. network analyzer has shown the convenience and economic saving that may be effected by carrying a stock of a few types of standard units. The design of such standard units is discussed in detail. (England.)

On Automatization of Introducing Some Types of Data in a Computer, V. S. Fain. "Avto. i Tel." 3 pp. The way of automatic transformation of functions which are given as charts, tables or other visible forms into a numerical (table) form. (U.S.S.R.)

The Packaged Analogue Computer, J. C. Cockram. "Proc. AIRE." Dec. 1960. 4 pp. A short description is given of a general purpose analogue computer composed of up to 18 computing units. (Australia.)

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
El Tech. Electronic Technology
GEC J, General Electrical Co. Journal
J. BIRE, Journal of the British Institution of Radio Engineers
Proc. BIEE, Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Bull. Fr. El Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
El. et Auto. Electronique et Automatisme
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Ubertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
Nach. Z. Nachrichtentechnische Zeitschrift
Rt. Regelungstechnik
Rundfun. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechnizne

USSR

Avto. i Tel. Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radioteknika i Elektranika
Rad. i. Elek. Radioteknika i. Elektranika
Iz. Acad. Bulletin of Academy of Sciences USSR

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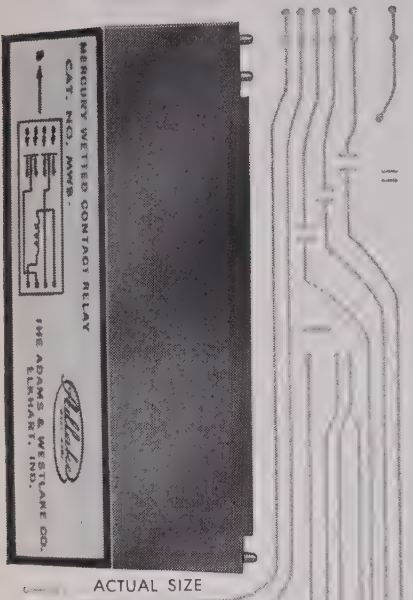

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Sources

An Analogue Computer for Aerial Radiation Patterns, H. Page, et al. "Elec. Eng." April 1961. 7 pp. An analogue computer has been constructed to calculate the horizontal radiation patterns of aerial arrays comprising a number of radiating elements mounted on a central support mast. The radiation pattern of a single element must be known and from this the pattern for a number of identical elements round the mast may be calculated. (England.)

Data Handling by Computers and Utilization of the Resultant Information in Control Loops, E. Krochmann. "rt." April 1961. 7 pp. The use of computers in normal control systems is surveyed with particular consideration of the measurement of the controlled variable, in data sampling, and in displacement or position control systems. (Germany.)

A High Speed Analogue to Digital Convertor, N. Winterbottom and J.S.B. Walters. "Elec. Eng." March 1961. 6 pp. An account is given of a high speed analogue to digital convertor capable of performing 55,000 conversions/sec. from an analogue voltage to an 8-bit binary code. The equipment uses transistors as the active elements. (England.)

CONTROLS

On Compensation of Time-Delay in Relay System, N. A. Korolev. "Avto. i Tel." May 1961. 8 pp. The way of stabilizing an automatic control relay system with time-delay is described, a second-order system being taken as an example. (U.S.S.R.)

Hysteresis Influence on Periodic Process in Pulse-Relay System, V. P. Kazakov. "Avto. i Tel." May 1961. 5 pp. Approximate determination of periodic behavior in automatic control pulse-relay systems which is expounded in (1) is applied to the case when relay characteristic of a pulse element possesses hysteresis. (U.S.S.R.)

Servosystem with Two-Phase Asynchronous Motor Which Control Winding is Supplied from Current Generator, N. P. Vlasov. "Avto. i Tel." May 1961. 6 pp. An ac servosystem with asynchronous motor which control winding is supplied from a current generator is considered. (U.S.S.R.)

To Theory of One-Type Coordinated Automatic Control Systems with Symmetric Cross Bands, V. T. Morozovsky. "Avto. i Tel." March 1961. 16 pp. Principles of constructing equivalent one-loop systems for one-type multi-channel automatic control systems with symmetric cross bands are considered. The idea of synchronizing and averaging cross bands is introduced. The technique of determining reduced disturbances is given. (U.S.S.R.)

Optimum Second Order Relay Servomechanisms, A. Gosiewski. "Roz. Elek." Vol. 7 #1. 52 pp. The elements of systemized theory of the time-optimized automatic control systems i.e. systems distinctive by the shortest response time, and their applications to synthesis and analysis of the basic types of the second order relay servomechanisms with current or voltage controlled servomotor are considered in the paper. (Poland.)

Design of Automatic Control Systems, I. Borodin & V. N. Plotnikov. "Avto. i Tel." April 1961. 14 pp. A design technique of automatic control systems without delay is given which is the case of first and second order objects for four types of regulators. The technique is generalized on systems with an object delay. Nomograms for choice of desired transfer function parameters and for determination of a regulator type are given. (U.S.S.R.)

Optimum Servodrive with Two Control Parameters, A. E. Bor-Ramensky, Sun Tzjan. "Avto. i Tel." Feb. 1961. 14 pp. A technique of synthesis of an optimum high-speed electrical servodrive is expounded. (U.S.S.R.)

Paper Tape Control Permits Automatic Programming of Radio Stations, Glen A. Robitaille. "Can. Elec. Eng." April 1961. 5 pp. An automatic programming system has been developed at radion station CFPL, London, to permit unattended operation of the station at night. It is controlled by punched paper tape to achieve maximum flexibility and reliability. (Canada.)

Concerning Properties of One-Loop Automatic Control System, L. G. Sobolev. "Avto. i Tel." April 1961. 6 pp. Stability conditions of some types of one-loop systems are represented as interdependence of critical power gain and parameters of separate units that permits determination of some properties of the systems. (U.S.S.R.)

Analytical Design of Controllers IV, A.M. Letov. "Avto. i Tel." April 1961. 11 pp. With the help of the dynamic programming method, a problem of analytical design of controllers optimized according to integral square error is solved. (U.S.S.R.)

On Method of Correction of Dynamic Properties of Automatic Control Systems, V. S. Lerner. "Avto. i Tel." April 1961. 14 pp. The paper deals with a method of correction for an automatic control system based on change of the system structure via deviation signs of controlled parameters before and after system elements which are to be corrected. (U.S.S.R.)

Applications of Magnetic Amplifiers for Small Drives, Wilfried Fritzsche. "AEG Prog." #1, 1960. 7 pp. Transductors which work only with static elements are good regulating units for small drives. A good method of controlling the speed of dc shunt motors is by varying the armature voltage by means of magnetic amplifiers. The actual-speed signal is derived from voltage bridges or special multi-phase tacho-generators. A reversing circuit for armature feed is also discussed. For position-control systems transductor-fed, 3-phase induction motors can be used with advantage. A feedback is described which requires no tacho-generator. (Germany.)

GENERAL

A Small Getter Ion-Pump, A. Klopfer and W. Ermrich. "Phil. Tech." No. 8, 1961. 6 pp. The advances made in vacuum technique in the last ten years have given a new lease of life to the apparently outmoded idea of continuously pumping a vacuum tube during operation. (Netherlands, in English.)

The Design of Lens Hoods. "BBC Mono." April 1961. 5 pp. The factors which control the performance of a lens hood are discussed. (England.)

Analysis of Non-Linear and Extremal Pulse Systems on Difference Phase Plane, V. M. Kuntsevich. "Avto. i Tel." May 1961. 10 pp. Some non-linear and extremal pulse systems on difference phase plane are analyzed. The technique of using a difference phase plane is somewhat developed and defined more precisely. Switching boundaries are determined. Pulse and non-linear correction systems and time-delay systems are investigated. (U.S.S.R.)

On Application of Two-Dimensional Laplace Transformation to Determination of Correlation Function of Output Signal in Linear Dynamic System, A. N. Sklyarevich. "Avto. i Tel." May 1961. 6 pp. An idea of incomplete representation of a weighting function is introduced. Properties of this incomplete representation are formulated. (U.S.S.R.)

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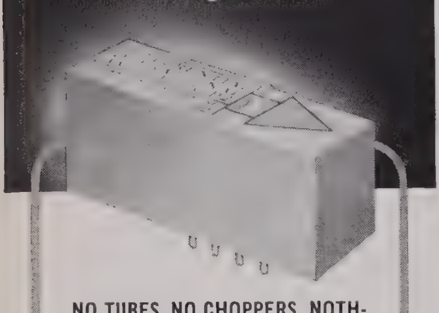

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Sources

The Voltage Regulation of Large Synchronous Generators with Amplidyne Rotary Amplifiers and Transductor Regulators, Hans Junior. "AEG Prog." #7, 1961. 11 pp. The increasing energy consumption necessitates new generating plant either turbo-generators or hydroelectric generators. The higher ratings of the individual units and the conditions in the supply networks have presented new problems for voltage regulation, which will be briefly considered and described. (German in English.)

New Design of Crossbar Multiselector, Z. Drozd. "Prace ITR." Vol. 4, #4. 19 pp. The paper describes a new construction of crossbar multiselector recently elaborated in Warsaw. In this selector the horizontal bars with selecting fingers made in the form of rigid levers are used, resulting in higher reliability and lower production costs. (Poland.)

The Switching Transductor, Method of Operation and Applications, Alfred Lang. "AEG Prog." #7, 1961. 11 pp. Based on the bistable control characteristic of the self-excited magnetic amplifier and the various self-excitation (feedback) circuits, the characteristic data of the switching transductor—feedback factor, loop width, switching ratio and insensitivity are derived. (German in English.)

Design Data for Band-Pass Ladder Filters Employing Ceramic Resonators, R. C. V. Macario. "Elec. Eng." March 1961. 7 pp. In the article design feasibility data for a variety of networks are examined and given in the form of graphs with exact design data as tables. (England.)

A Novel Digital Clock, A. Russell. "Elec. Eng." March 1961. 5 pp. The design and operation of a novel digital clock which registers the month, day, hour, minute, experimental number and test number on illuminated in-line indicators is described. (England.)

The Movements of Human Eyes: Electronic Recording Techniques, G. H. Byford. "Brit. C.&E." May 1961. 6 pp. Some of these techniques are described particularly where they may have applications in other quite unrelated fields. (England.)

The French Electronics Industry, Dennis Rose. "Brit. C.&E." May 1961. 5 pp. During the past ten years electronics has emerged as one of France's fastest growing industries. It is expanding at an approximate rate of 25% a year, and employs over 60,000 people. With the common market now operating, there is a tendency towards mergers and a much greater concentration of effort. (England.)

Effect of Shearing on the Initial Permeability of Tapewound Cores, R. Brenner and F. Pfeifer. "Freq." March 1961. 3 pp. With tape-wound cores the shearing is usually far smaller than with cores composed of punched laminations, but sometimes it wins technical importance, in particular in the present era of miniaturization. It is theoretically studied and represented by formulas as a function of core dimensions and permeability of the material. (Germany.)

The Effect of a Voltage with Instantaneous Step Changes in Phase and Frequency on a Tuned Amplifier. A. P. Moltchanoff. "Radiotek" 16, No. 4, 1961. 5 pp. Considered are transient phenomena which occur in a tuned amplifier with simultaneous jumps in frequency and phase of the impressed emf. The transient phenomena are minimized, when certain particular relations exist among jumps in the frequency and the initial phase. (U.S.S.R.)

Pauses During the Dialing Process in Telephone Networks, G. Rothert, H. Evers, "Nach. Z." April 1961. 4 pp. The statistical distribution of the dialling pauses in local and trunk dialling is reported. (Germany.)

The Electrical Operation of Contacts in an Inert Gas Atmosphere when Inductive Loads are Switched, K. L. Rau. "Nach. Z." May 1961. 7 pp. It is shown that the glow discharge occurring during the disconnection of inductive loads without spark suppression determines the life of the contacts while other forms of discharges and the closing process is only of secondary importance. The physical laws characterizing glow discharges are derived and the energy of the magnetic field as a factor determining the life is discussed. (Germany.)

Codes Based on Switching Functions and Their Application in Practical Coding Methods, P. G. Neumann. "Nach. Z." May 1961. 8 pp. A class of codes is developed, for which the disadvantages of the optimal codes can be avoided. (Germany.)

Distortion of Steep Voltage Pulses due to Finite Transit Time Between the Deflecting Plates, H. Lotsch. "Freq." May 1961. 7 pp. With an oscilloscopic display of very steep voltage pulses, the rising edge of the screen trace will appear distorted as compared to the pulse edge under test, if the rise time T of the pulse under test is comparable to the electron transit time between the deflecting plates. (Germany.)

Magnetic-Thermistor Time Relay, O. P. D'yakov, et al. "Avto. i Tel." May 1961. 6 pp. A time relay is proposed which includes a pulse generator and a pulse counter. (U.S.S.R.)

Practical Method of Estimation of Connection Operator in Linear Approximation, L. N. Lipatov and P. Leonov. "Avto. i Tel." May 1961. 10 pp. Simple numerical determination of a weighting function of a linear object is considered. An example of estimating the weighting function of connection among parameters of a uniflow boiler is given. (U.S.S.R.)

Photoelectric Cells and Photomultipliers, J. Sharpe. "El. Tech." June 1961. 6 pp. It is the aim of this survey to present in simple terms a discussion of the properties and applications of photoelectric cells and multiplier photo-tubes with special emphasis on the advantages and limitations of the latter. (England.)

Harmonic Analysis with Respect to Amplitude and Phase, D. Luke and W. Schussler. "Nach. Z." May 1961. 7 pp. A discussion of the conditions and possibilities for a harmonic analysis with respect to amplitude and phase of electric time functions is followed by a description of an analyzer which can easily be assembled from commercially available equipment. (Germany.)

Automatic Pneumatic Optimizer, N. V. Grishko. "Avto i Tel." May 1961. 10 pp. Operation of an automatic optimizer is described. Choice of optimum parameters is considered. Results of testing an object electronic model are given. (U.S.S.R.)

MATERIALS

Preliminary Works on Laboratory Processing of Very Stable Ceramic Materials for Radio Components. "Prace ITR." Vol. 5, #1. 7 pp. Basic technology of Celsianum Synthesis used for laboratory preparation of the materials is given. (Poland.)

Germanium-Bicrystals and their Application for Grain-Boundary Photocells, H. F. Matara. "El. Rund." May 1961. 5 pp. Part 2 of this paper deals with the electronic consequences of the model for bi-crystal interfaces as discussed in Part 1. The bi-crystal interface has interesting electrical properties since it originates from a close overlap of the dangling bonds in a geometrically defined way. These properties are described in detail especially the degenerate conductivity, the barrier layer action and the good photoelectric sensitivity. (Germany.)

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GENERAL DYNAMICS / ELECTRONICS

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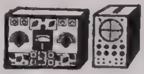
Sources

The Selection of Contact Materials for Telephone Links, L. Borchert. "Nach. Z." April 1961. 5 pp. The selection of a suitable contact material is in fact a compromise taking into consideration all types of effects. Numerous investigations under operational conditions have shown that silver-palladium alloys with 30 to 50% palladium are a technically and economically suitable solution for voice-frequency circuits. (Germany.)



MEASURE & TESTING

Electronics and Automatization in the Petrol Industry, S. S. Denisov. "El et Auto." June 1961. 7 pp. This first part of the paper covers thermocouples and measuring potentiometers, balance null indicators, thermometers and sense discriminators. (France.)

Radio Astronomy From Space Vehicles, R. C. Jennison. "Brit. C & E." July 1961. 4 pp. This article discusses ways in which radio astronomy measurement from sources in outer space can be made from equipment carried in earth satellites. (England.)

Measuring the Doppler Frequency Shift on Satellite Transmissions, R. E. Henderson. "Brit. C & E." July 1961. 7 pp. Equipment developed for recording and analyzing the Doppler frequency shift on a single frequency or on a pair of harmonically related frequencies is described. (England.)

A Blood Cell Counter, G. P. Burn, P. J. Tosh. "Elec. Eng." July 1961. 2 pp. This article describes Coulter's method for counting blood cells. The apparatus enables 10,000 cells to be counted in about a minute, using Dekatrons. (England.)

Measuring Pressure Fluctuations in Flight, M. A. Perry. "Brit. C.&E." April 1961. 5 pp. The thin wings of military aircraft and high speed supersonic airliners often experience separation of the laminar boundary layer at the leading edge giving rise under certain conditions, to severe buffet and vibration of the wing. This article describes a measurement technique employed for the determination and analysis of the stresses set up. (England.)

On Errors of Measuring Device Controlling Change of Variable in Equal Periods of Time, V. A. Volkonsky. "Avto. i Tel." April 1961. 4 pp. A device which measures a certain variable in discrete moments of time and signals about variable surpassing the permissible level is considered. (U.S.S.R.)

Definition and Measurement of Pressure Drops, G. Hutarew. "rt." April 1961. 2 pp. When measuring pressure drops all conditions must be excluded which could prejudice the accuracy of the results. (Germany.)

RADAR, NAVIGATION

Secondary Surveillance Radar, D. H. R. Archer. "Elec Eng." July 1961. 7 pp. In this article the principles and fundamental characteristics of secondary radar are discussed and some of the system design problems are set forth. (England.)

The Goniomatic (Type RC 235) For Use On Light Aircraft, M. P. Rousset. "Onde." May 1961. 8 pp. This article describes the advantages of a completely transistorized navigational aid for use on light aircraft. (France.)

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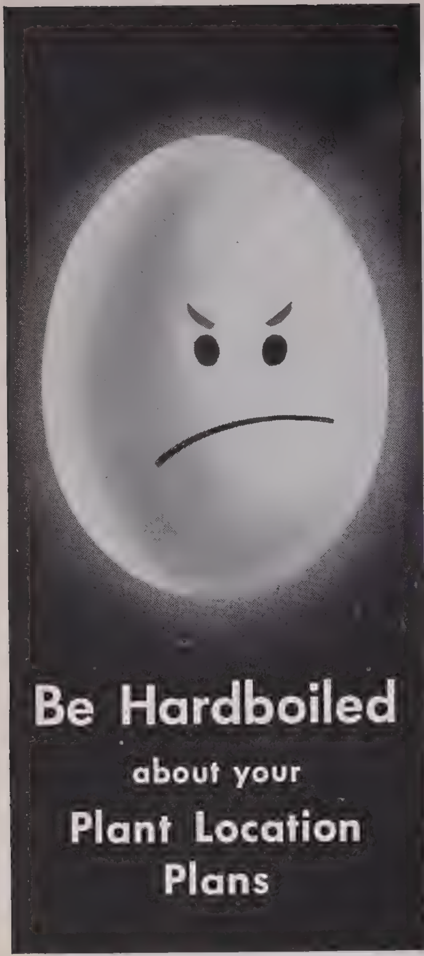

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Sources

The Problem of Civil Air Traffic Control on the Basis of the Information Theory, H. Meinke. "Nach Z." June 1961. 6 pp. The information rate which originates from the location measurement of a flying aircraft is extremely small and has been calculated. The extremely high outlay for the planned three-dimensional radar systems which are not matched to the information rate stands in contrast to this information rate. It is shown in this paper that the problem of air traffic control can also be solved by means of a much simpler radar system when the aircraft flying in the controlled space meet certain flight rules. (Germany.)

Radar Systems in Band L: (Orly Type), R. Cliquot. "Onde." May 1961. 15 pp. The elimination of fixed echoes is obtained by means of C.S.F. equipment which employs memory tubes. (France.)

Echolocation by Bats, J. D. Pye. "Endeavor." April 1961. 11 pp. It has now been shown that bats do in fact navigate and find their food by means of an echolocation system using sounds of very high frequency. The process is very rapid, accurate, and resistant to jamming. (England.)

The Echo Box, its Theory and Application in Radar, G. Pusch. "Nach. Z." April 1961. 6 pp. An echo box is a tuneable cavity resonator with a high Q-value. It is used for producing artificial echoes in radar equipments. The most important measurements on the radar equipment can be carried out with this means. More particularly, the efficiency s which is a difference between the transmitted level P_s and the noise level P_r can easily be determined by a measurement of the "resonating time." The formulae, which are most important in practice are derived accurately and design details are discussed. (Germany.)

A New Assessment of the Gee System, D. H. R. Archer. "Brit. C.&E." April 1961. 4 pp. In this article the author expresses some opinions on the past, present and future of the system. (England.)

Siting of Microwave Systems in a Radar Environment, A. J. Kingan and L. W. Dennison. "Can. Elec. Eng." June 1961. 9 pp. If satisfactory siting, development and operation of radar and microwave systems in a common environment are to be realized, close cooperation between radar and microwave system engineers will be required, whether a new system is being designed or an existing system is being expanded. (Canada.)

SEMICONDUCTORS

Thyratron Transistor Amplifier, M. V. Ol'-Shvang. "Avto. i Tel." April 1961. 8 pp. Operation of a thyratron transistor amplifier is considered in which triodes are completely open up to the moment when collector current passes across the null. (U.S.S.R.)

Transistorized Timing Circuits, R. Duchamp. "El. et Auto." May 1961. 3 pp. This paper presents summarily the fundamental principles of time constant circuits and describes several practical applications: simple timer, adjustable timer, long time constant timer, precision timer, pulse shaping circuit, pulse counter, and delay circuit. (France.)

Analysis of a Cascode Tuned Transistor Amplifier, Y. G. Kriukoff, Y. L. Simonoff. "Radiotek" 16, No. 3, 1961. 6 pp. In this article the author analyzes a particular cascode configuration (common emitter-common base), used to neutralize the shortcoming of transistor internal feedback in tuned amplifier. (U.S.S.R.)

Methods of Producing Stable Transistors, J. J. A. Ploos van Amstel. "Phil. Tech." #6, 1961. 11 pp. One of the major problems in the manufacture of transistors is to make them stable, i. e. to produce transistors whose characteristics do not change in the course of time. Such changes are due to surface effects. It is therefore necessary to produce surface conditions that will minimize these changes. (Netherlands, in English.)

Transistor Applications, R. Duchamp. "El. et Auto." March-April 1961. 3 pp. This first paper of a series devoted to simple applications of transistors covers multivibrator circuits. Their principle and simplified design are introduced, and simple applications are presented. (France.)

4-Layer Diode Applications, W. Shockley and J. F. Gibbons. "El. et Auto." May 1961. 3 pp. The first part of the paper recalls the operation of a 4-layer diode and studies the transient effect. The second part of the paper deals with bistable multivibrators, square wave generators, high efficiency inverters, high reliability inverters. (France.)

Control of Solid State Thyratrons, A Levy-Soussan. "El. et Auto." March-April 1961. 5 pp. This article presents several on or off switching methods, which apply to common circuits. It points out necessary safety features and explains the advantages and drawbacks of various methods. (France.)

Magnetic Amplifiers in Semiconductor Rectifier Apparatus, Erich Schroeter. "AEG Prog." #7, 1961. 5 pp. Characteristics as required for the various applications of adjustable and automatically controlled semiconductor rectifier apparatus are discussed. (Germany, in English.)

Solid-State Research at Low Temperatures—II. Electron Conduction in Metals and Semiconductors[1], J. Volger. "Phil. Tech." #7, 1961. 6 pp. Following the previous articles in this series, which was mainly introductory, the article deals with various recent investigations on solids at low temperatures. (Netherlands, in English.)

Transistor Switching-Circuit Design Using the Charge-Control Parameters, R. Beaufoy. "ATE J." Oct. 1960. 12 pp. The charge-control parameters are introduced by considering the operations of switchng on, holding on and switching off a transistor, and a simple figure of merit for a switching transistor is derived. (England.)

Lightning Protection for Transistor Repeaters, R. W. Blackmore & B. A. Pickering. "ATE J." Oct. 1960. 16 pp. The nature of a lightning discharge is briefly considered and an explanation given of the resulting voltage surges likely to appear in buried and aerial coaxial cables. (England.)

Hot Electrons in Semiconductors and Their Applications, L. W. Davies. "Proc. AIRE." March 1961. 6 pp. A brief survey is given of electron heating phenomena in semiconductors, and of their application in some useful devices; these include avalanche injection diodes, avalanche transistors and p-n-p-n diodes. (Australia.)

Parametric Amplifiers, G. B. Stracca. "Alta Freq." March 1961. 11 pp. Among the various microwave applications of the non-linear reactances found in reverse-biased semiconductor diodes (varactors), this paper deals with low noise amplifiers. (Italy, in English.)

The Transistorized Vertical Deflection Amplifier in TV Receivers, W. Blinkiewicz. "Prace ITR." Vol. 5, #1. 12 pp. The paper deals with the operation and design problems of a transistorized vertical deflection amplifier. (Poland.)

Solid-State Research at Low Temperatures: III. Thermal Conduction in Insulators; Paramagnetism; Dielectric Losses Related to Chemical Lattice Imperfections, J. Volger. "Phil. Tech." No. 8, 1961. 10 pp. In this third and last article in the series on solid-state research at low temperatures, further examples are given of recent investigations. (Netherlands, in English.)

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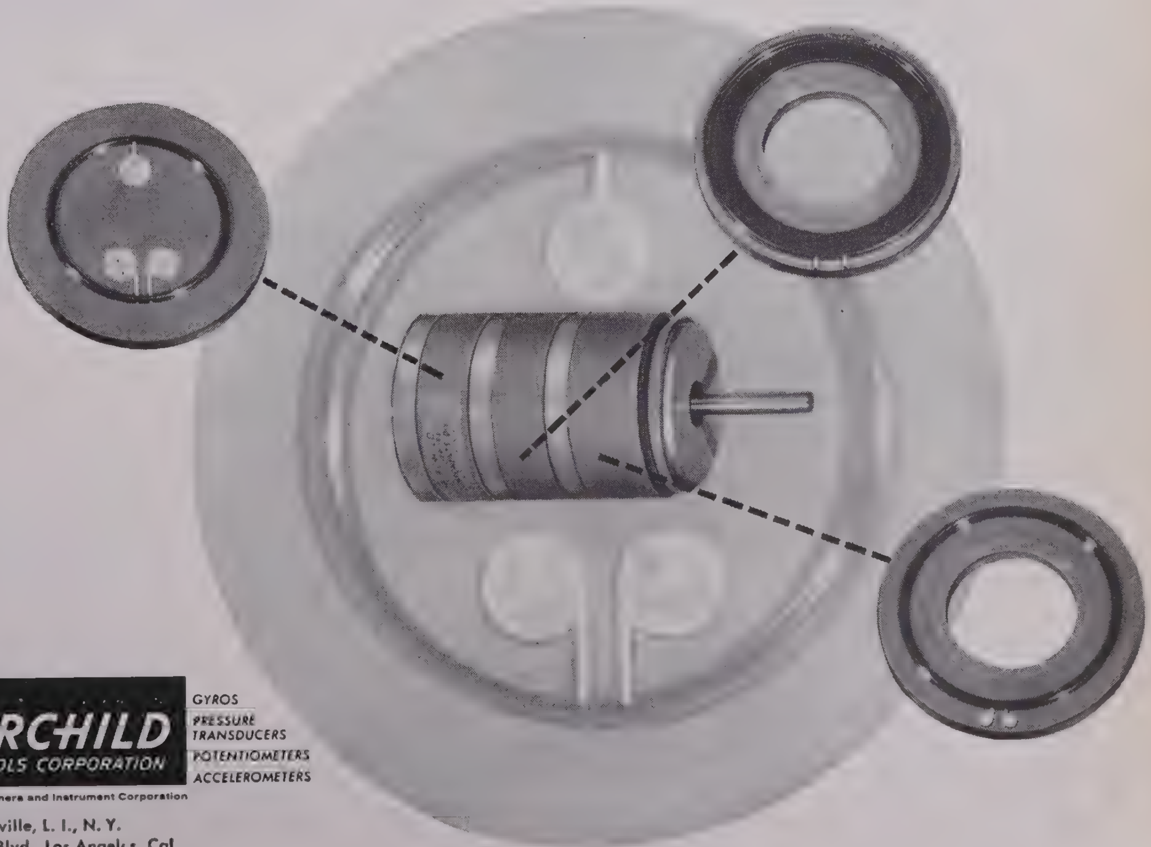

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International ELECTRONIC SOURCES

Transistor Precision Pulse Shaper with Short Recovery Time, I. De Lotto. "Alta Freq." March 1961. 5 pp. The pulse shaper with RC timing networks is discussed. This type of timing network and the influence of transistor characteristics on the performance of this circuit are analyzed. (Italy, in English.)

TELEVISION

Precision Offset for NTSC Color Subcarrier, J. Muller and F. Jaeschke. "El Rund." June 1961. 4 pp. Maurice's investigations have shown that the carrier disturbance in the NTSC color and compatible monochrome picture can be reduced when the conventional line offset is substituted by a precision offset to lock the color subcarrier to the sync frequency. (Germany.)

A New Television Tape Recorder, N. Sawazaki, et al. "Rundfunk." June 1961. 4 pp. The new recording process uses only a single revolving head and provides continuous recording of the entire television field on oblique tracks across the magnetic tape. Problems previously encountered with multiple-head systems are avoided and simplification in both construction and operation results from this innovation. (Germany.)

Electronic-Cam, a New Production Method for Film and Television. "Rundfunk." June 1961. 7 pp. The method, which in itself was not novel, has been developed into a method that has the advantage of producing the highest picture quality in a surprisingly simple manner, while at the same time affording a degree of operational reliability and economy that surpasses all others in this field. (Germany.)

Investigations into the Offset Operation of Television Transmitters with Wide Frequency Separation of the Vision Carriers, Herbert Hopf. "Rundfunk." June 1961. 11 pp. After a detailed description of the measurement arrangements, the paper describes a large number of investigations into signal-to-interference ratios, many of which refer to measurements made involving the same standard and differently-placed vision carriers. (Germany.)

Television Transmitting Aerials for the Decimetric Waves, Walter Stohr. "Rundfunk." June 1961. 12 pp. Starting from wideband transmitting aerials for the VHF range the paper describes various types of aerials that are suitable for television transmitting systems in the UHF range. (Germany.)

TRANSMISSION

Automatic RF-Channel Switching in the Wideband Radio Link System, H. Noack and M. Jung. "Nach Z." June 1961. 7 pp. Wideband radio link systems for telephone and TV transmission must be extremely reliable in consequence of their importance. For this reason long distance networks with several parallel RF-channels are provided with an unloaded but operating spare channel which can be loaded automatically or manually with the information of a faulty channel. (Germany.)

Noise Stability of Remote Control Frequency System with Fluctuation Noises, I. Chugin. "Avto. i Tel." May 1961. 15 pp. Noise stability of remote control system with a frequency-modulated carrier and with detection of subcarrier orders in the case of arbitrary fluctuation noise-level is determined. (U.S.S.R.)

The Propagation of H_{01}-Mode Waves in Bent Circular Waveguides, G. Morgenstern. "Nach Z." June 1961. 8 pp. A summary of the effects of bends in circular waveguides for the transmission of H_{01}-Mode waves is followed by a theoretical and experimental investigation of a bend designed in the "Heinrich Hertz Institute." (Germany.)

Propagation of E. M. Waves Along a Helix, R. Dingeldey, A. Cunliffe. "El Tech." July 1961. 5 pp. The introduction of an inner conductor along the axis of a helix for the purpose of providing electrostatic focusing in a travelling-wave tube is shown to form a system which can propagate a fast wave as well as a slow wave. (England.)

Nature and Engineering of Information Transmission and Processing. "El Rund." June 1961. 6 pp. Problems of Input and Processing of Information in Organisms and of Learning in Machines. This report is a digest of fundamental ideas expressed in a number of papers presented at the NTG meeting in Karlsruhe, Germany, 11 to 14 April 1961. (Germany.)

Remote Control of Pilotless Aircrafts, G. Greneche. "Onde." May 1961. 15 pp. The author gives first an indication of the means required by the operator. Two radio-links are necessary: one for remote control, one for telemetering. A transmission principle common to both types of links is described. (France.)

Investigation of Thyratron Pulse Transformer with Stepping Motor, V. M. Kolesnikov. "Avto. i Tel." May 1961. 11 pp. Analytical and experimental investigation of steady-state and transient processes of transforming descrete electrical pulses into mechanic turn angles as applied to pulse transmission with three-stator stepping motor is described. (U.S.S.R.)

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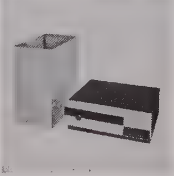

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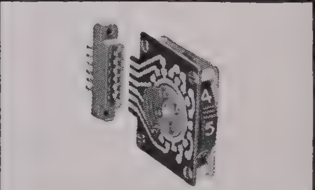

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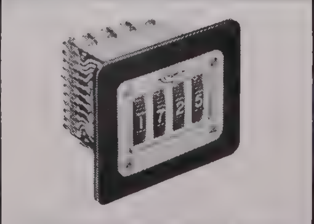

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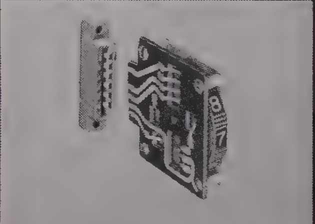

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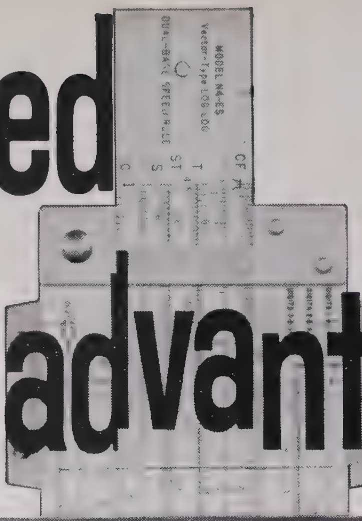

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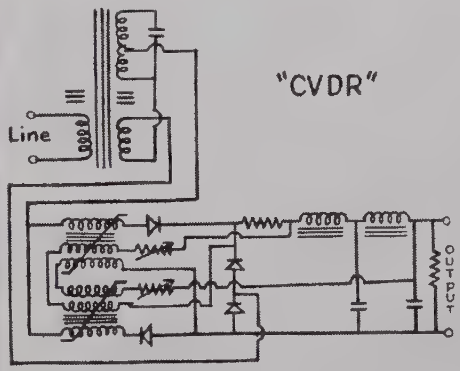

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Electronic System 'Watches' Intensive-care Patients

THIS electronic medical system automatically and simultaneously measures and records temperature, pulse rate, respiration rate, diastolic and systolic blood pressure of a dozen or more hospital patients every 2 min.

The system is called a Body Function Recorder. It was developed by Minneapolis-Honeywell in cooperation with medical authorities from the Mayo Clinic in Rochester, Minn., for use in the intensive care of post-operative and critically ill patients.

Because it monitors patients individually, a doctor can set danger limits for each of the five variables depending on his patient's illness rather than use average medical figures. For example, a doctor may decide that an extremely rapid pulse rate is normal for an individual but that even a slight temperature increase calls for immediate action. Two control dials can be pre-set by a nurse to provide the alarm.

Providing instantly readable medical records for each patient, it will automatically sound an alarm if any patient's condition reaches a dangerous stage.

Physically, the Body Function Recorder consists of a patient headpiece containing 3 transducers, connected to the necessary circuitry to make the measurements and a recorder-alarm unit.

When it is desired to have a single nurse monitor the condition of several patients, recorder-alarm units for each are grouped together into a central station console or panel. Also available are consoles containing single recorder-alarm units that can be moved from one bedside to another.

Most unusual of the 3 transducers used is a "clothespin" type earpiece that slips over the upper portion of the patient's ear. It measures diastolic and systolic blood pressure and pulse rate by shining a light through the patient's ear onto a photocell.

The temperature transducer is a small clip that is nserted into the corner of the mouth, while respiraion rate is determined by an air-flow detector about he size of a silver dollar that is positioned in front of the mouth and under the nose.

* * *

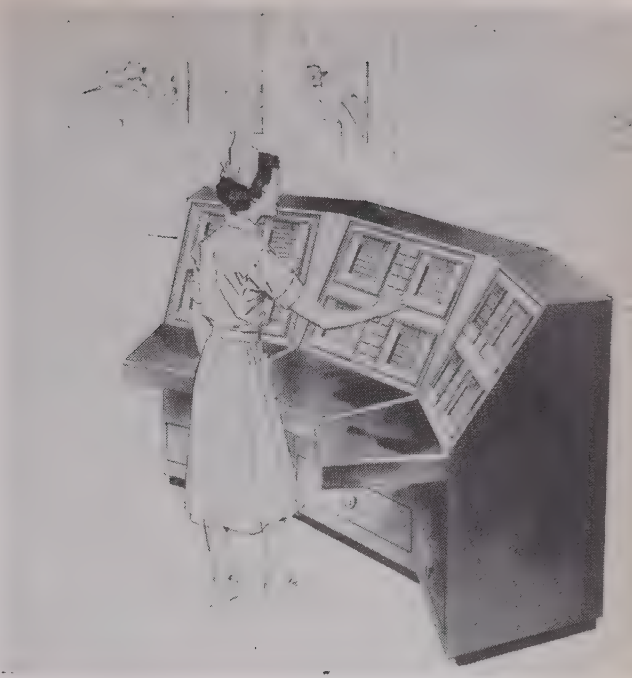

Fig. 1: A single nurse can monitor the condition of a dozen intensive-care hospital patients with this Minneapolis-Honeywell electronic medical system. Mounted on the nurse's central station console is a recorder-alarm unit for each of the 12 patients.

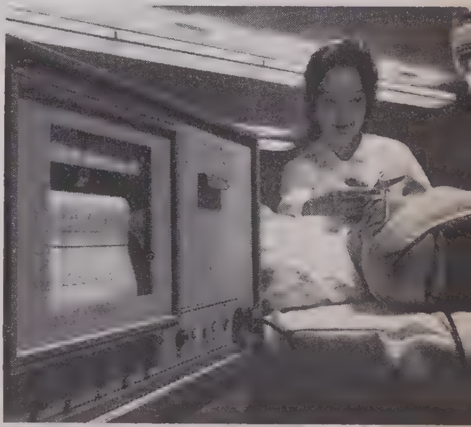

Fig. 2: A single Body Function Recorder, at bedside, measures and records the 5 variables for an individual hospital patient. The headpiece worn by the patient, contains 3 transducers used to make measurements.

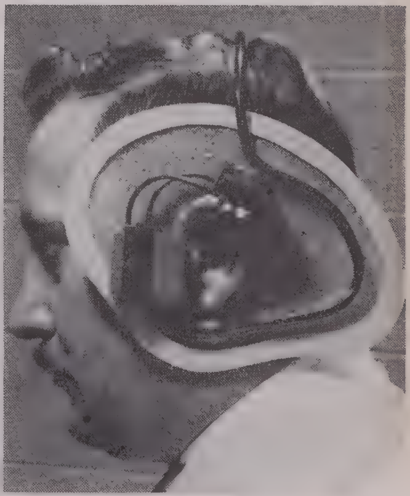

Fig. 3: An "earful" of essential medical information is provided by the "clothespin" type transducer clipped to the ear of this hospital patient. It measures diastolic and systolic blood pressure and pulse rate by shining a light through the patient's ear onto a photocell.

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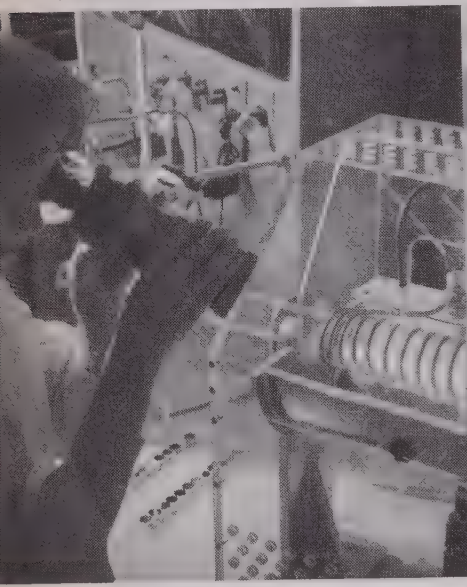

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Tele-Tech's ELECTRONIC OPERATIONS

The System Engineering Section of ELECTRONIC INDUSTRIES · SEPTEMBER 1961

SYSTEMS—WISE . . .

▸ **The Union Pacific Railroad has ordered a 400 mile Lenkurt Electric Co., Inc., Type 74B 6 GC radio system for service between Salt Lake City, Utah, and Cheyenne, Wyo. The new circuit will carry data, telegraph, and voice signals. The 13 repeater stations, one of them 9,200 ft. in the Rocky Mountains will accommodate up to 240 channels. For reliability, the equipment will be set up for hot standby operation.**

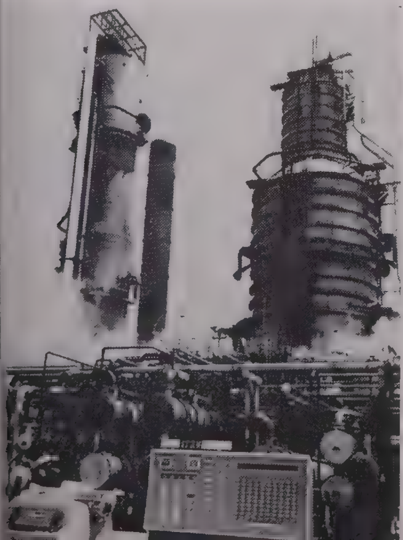
▸ The FAA has awarded a contract for 38 Visual Glide Slope Indicator systems to Sylvania Electric Products Inc. Systems will be installed at major commercial airports throughout the 50 states. Consisting of four banks of lights, the color of the lights will aid pilots in avoiding undershooting or overshooting and in using the full length of the runway. VGSI was originally developed by RAE, English counterpart of the FAA and Thorn Electrical Industries Ltd. of England, a Sylvania affiliate.

▸ **Aerojet-General Corp., Atlantic Div., has been awarded a contract for the design and installation of an advanced parcel post sorting system in the Biscayne Annex of the Miami, Fla. Post Office. The system will employ the "time sharing" concept permitting many parcel sorts with a single piece of equipment.**

▸ A $1 million transmitter, built to operate in the 20-60 MC freq. range and requiring a million-watt power supply, will be used to power America's largest steerable radar telescope for Stanford Univ. and Stanford Research Inst. later this year, in new studies of the solar system. The telescope, as tall as a 15-story building, has a parabolic reflector 150 ft. in diam. The transmitter was built by Continental Electronics Mfg. Co., Dallas, Tex., sub. of Ling-Temco-Vought, Inc.

▸ **All major contracts involved in the FCC's New York UHF-TV project have now been signed. This project is for the purpose of studying the technical and economic feasibility of using UHF channels to provide satisfactory coverage in a large metropolitan area.**

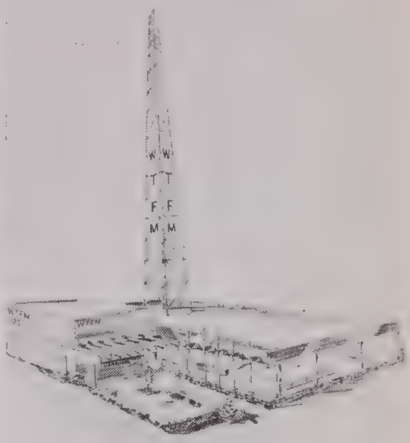
PROCESS CONTROL FOR DISTILLATION UNIT



American Oil Co. has installed a fully automatic, closed-loop, process control system developed by IBM at its 140,000-barrel-a-day crude oil distillation unit, at Whiting, Ind. The control system which will continuously monitor and control the crude unit is built around an IBM 1720 Solid-State Digital computer.

THREE-WAY SOUND CENTER

The nation's first 3-way sound center, located in Fresh Meadows, N. Y., will feature radio station WTFM, recording studios, and a luxury sound salon all under one roof. Center will be opened in September by Friendly Frost Inc. WTFM will be equipped with the RCA stereo console. The sound salon will retail limited editions of custom hi-fi and stereo music systems and the recording studios offer professional disc and tape recording facilities.



▸ **Sixty closed circuit TV cameras designed to withstand extreme temps of heat and cold and 48 monitor screens are being produced by Siegler Corp. under contract from The Martin Co. They are for operational sites of the Air Force Titan ICBM. The system will be installed in the underground control centers and in the silos to televise critical in-silo missile functions, including fueling.**

▸ A computer control system has been ordered by Celanese Corp. of America from Minneapolis-Honeywell Regulator Co., for its new multi-million dollar acetyl manufacturing plant being built at Bay City, Tex. The computer system will monitor input signals of flows, temps, pressures, liquid levels, specific gravities and other process variables at a max. scanning rate of 200 points per second. The system is built around the H290 High-Speed Digital Computer.

▸ **Western Massachusetts Electric Co. has just installed a remote control supervisory system for controlling the distribution of electric power. The equipment will watch remote substations serving the Pittsfield, Mass. area. The transistorized unit eliminates the need for manual operation and visual checks of line equipment. The solid-state system was built by GE's Medium Voltage Switchgear Dept., Phila., Pa.**

▸ An electronic plotting machine is doing the work of a staff of draftsmen by automatically preparing large quantities of highway cross-section drawings. King & Gavaris, consulting engineers, are using a model 2200 DATAPLOTTER built by Electronic Associates, Inc., N. J. Data is prepared by an electronic computer on punched paper tape which serves to instruct the plotter in its job of preparing the drawings automatically.

By PHILIP WHITNEY

Chief Engineer
R. F. Lewis Radio Stations
200 Shawnee Ave.
Winchester, Va.

Inexpensive Remote Pickup Transmitters

The newest FCC regulations permit use of mobile communications equipment for remote pickup. This equipment can be obtained very cheaply from surplus dealers. With the few modifications described here the equipment will perform very well.

MANY stations have discovered the convenience, economy and flexibility of remote pickup transmitters in the 26 and 150 MC bands. They are most useful for news, special events, sports and promotional broadcasts. With this equipment a broadcast can be originated within an hour after the decision is made to carry it.

In the past, the cost of this gear and the limited frequency range sometimes encountered has limited its use. Many stations with 26 MC transmitters have discovered lately that all is not rosy when this frequency is selected. Skip interference has wrought havoc with communications and many broadcast attempts in this band. But the flexibility of such equipment has whetted the appetite of the program department to continue its use.

Surplus Equipment

Fortunately there is a recent development which has made the path a little easier for the engineering department. It is the F.C.C regulation setting up the split

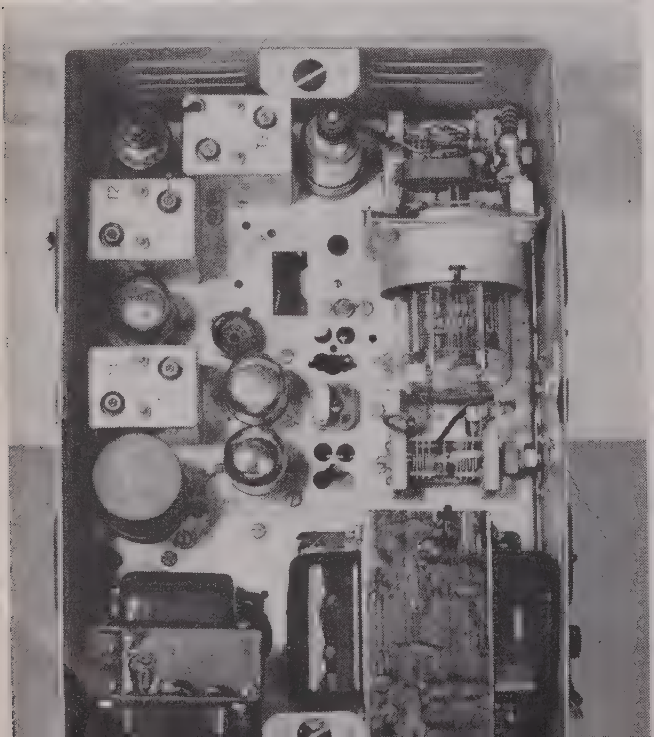


Fig. 1: Interior view of a converted Link Type 2240-ED2A transmitter. Unused parts have been removed from unit.

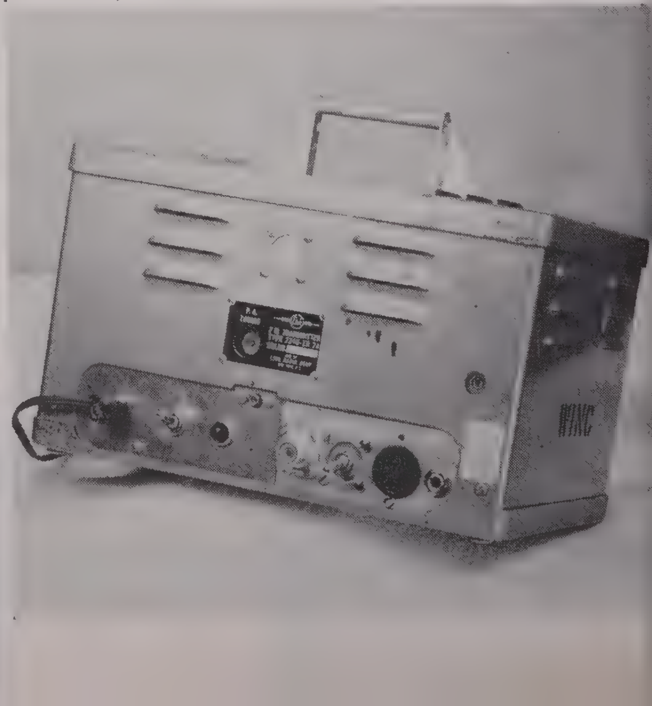


Fig. 2: Exterior view of Link 2240 transmitter. Note new control panel and handle. From left to right on control panel are the fuse, filament switch, pilot light, antenna socket, plate switch, test socket and 500 ohm audio input jack.

channel tolerances for mobile, and other applications in the 150 MC band. This has resulted in the availability of an amount of this gear on the surplus market at cheap prices. Link, Federal, Motorola and other units are available in power output ratings from 7 to 250 watts. A good many Link 50 watt units are going for from $19.95 to $150.00 a piece.

Our organization has about ten units operable in this range, including those made by all of the above-mentioned manufacturers. It has been no great problem to convert these units for program relay use, giving a frequency response substantially within ± 2db from 70 to 10,000 cycles, some to 20,000. Generally, the bass end of the spectrum has been the limiting factor. These units were generally designed to hold the frequency response down to a communications bandwidth of 300 to 3000 cycles. Most had a frequency swing of ± 15 to ±20 KC. This may easily be accommodated within the 60 KC channel width assigned to Remote Broadcast Pickup Stations. This equipment is licensable "as is" for use in this service. Generally no IDC is necessary.

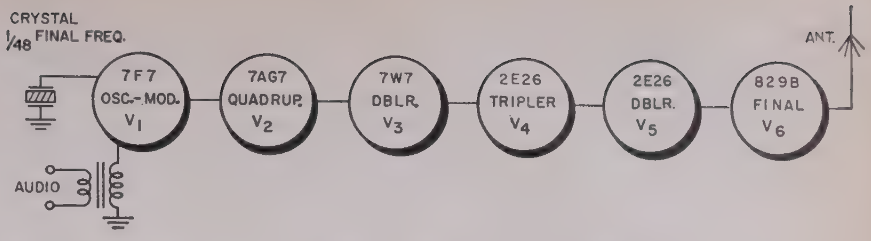


Fig. 3: Block diagram of the Link 2240 transmitter shows multiplier stages.

The purpose here is to outline conversions for these transmitter units and general instructions for building up units in the shop when no surplus units can be found. The station receiver will be covered in a later article.

Generally, available equipment is mobile, mostly for 6 volts. We use a few mobile, battery-powered units, but most of the conversions are to 117 volts. These can be quickly installed in a gym, trailer or store.

Equipment Modifications

One of the most easily obtained units is the Link Type 2240 (or 1906), with an 829B final amplifier and r-f output of 50 watts. A block diagram of this unit is shown in Fig. 3. We junked the cables and remote control head, cleaned the

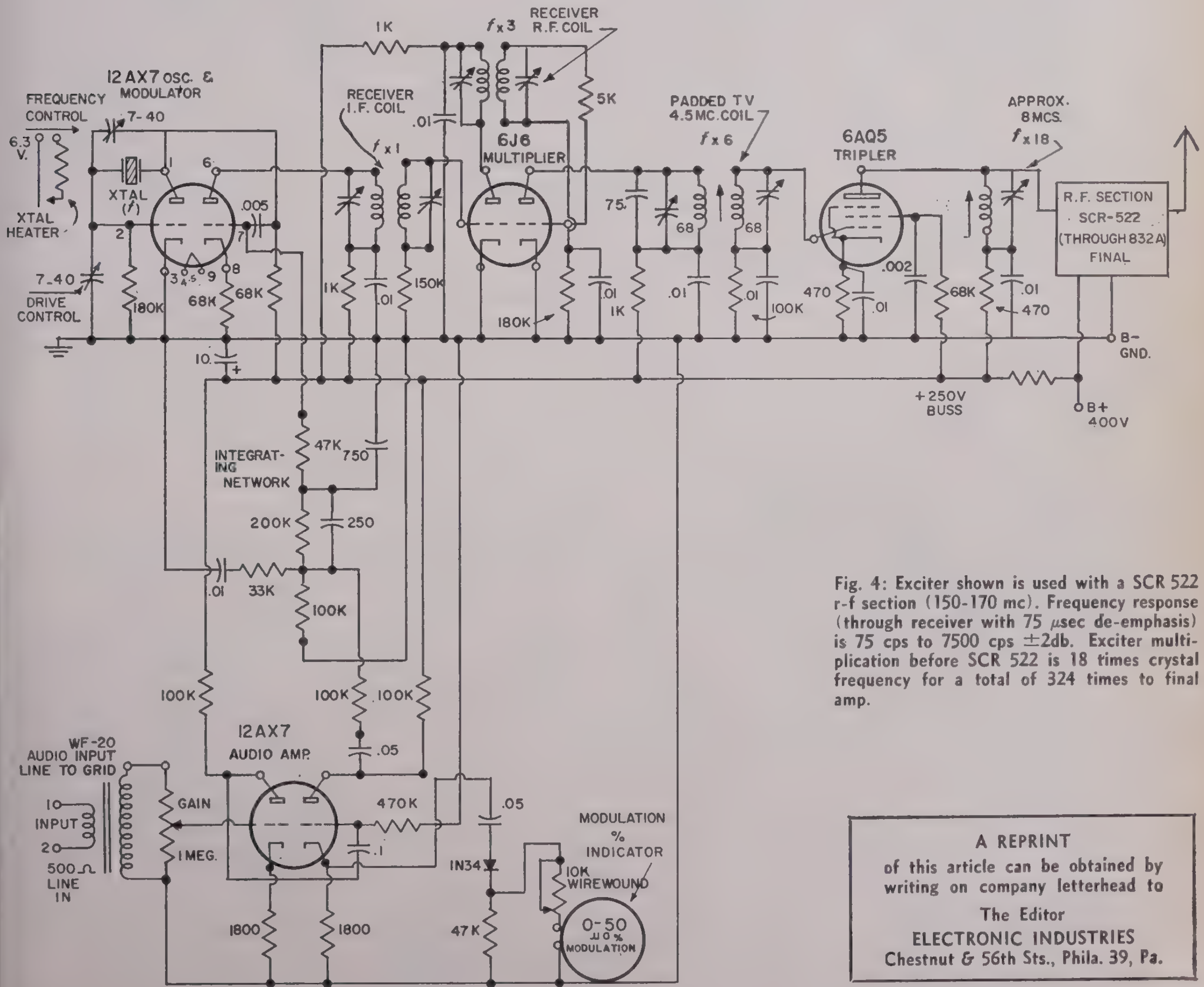


Fig. 4: Exciter shown is used with a SCR 522 r-f section (150-170 mc). Frequency response (through receiver with 75 μsec de-emphasis) is 75 cps to 7500 cps ±2db. Exciter multiplication before SCR 522 is 18 times crystal frequency for a total of 324 times to final amp.

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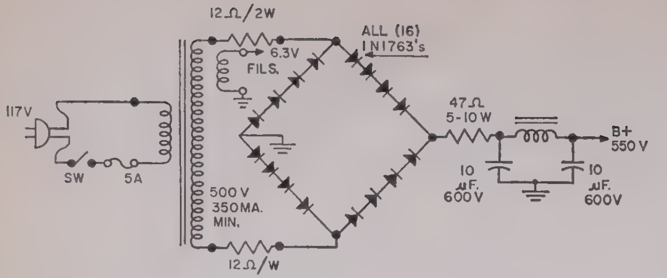

Fig. 5: An ac power supply for the Link 2240 transmitter.

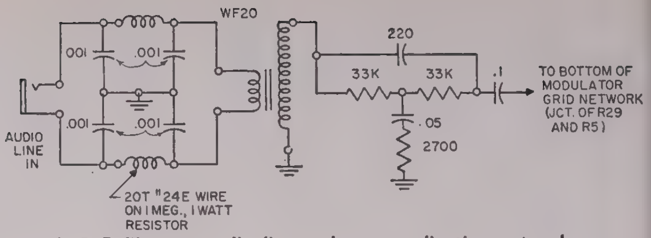

Fig. 6: R-F filter on audio line and pre-equalization network.

Remote Pickup

(Continued)

chassis down by removing the motor generator, all relays, front panel remote control and power connectors, antenna switchover relay, coaxial receiver antenna socket (leaving front panel test socket), 6AQ6 audio amplifier, IDC network and input audio transformer.

A type WF20 (Stancor) or other type 500 ohm to grid transformer with good frequency response is installed under the chassis. Keep it away from the new power supply, which is constructed on the chassis in place of the motor generator. The important remaining components on the chassis are the six r-f tubes and their related circuits. The output coupling loop, near the final tank, is brought up and soldered to the 831R "antenna" socket. The bottom end of the audio input transformer winding is connected to audio ground near the 7F7 modulator socket. The equalizing network (Fig. 6) is connected between the top of the secondary and the audio coupling capacitor, C33. C33 should be changed to at least a .1 mfd unit. (Small ceramic unit preferred.) Insert a "brute-force" r-f filter between the 500 ohm input transformer winding and the transmitter audio output. This will keep the high r-f level existing near the transmitter from getting into the audio.

After the transmitter is finished and tuned up, introduce audio tones into this input jack, while measuring output voltage and distortion from the receiver discriminator output (following the de-emphasis network) tuned to this frequency. (This receiver can be the modified receiver which matches the transmitter or a tuneable receiver such as the 152-172 Monitoradio).

It may be necessary to make slight adjustments in the components in the equalization network to get a flat response, since the transmitters vary enough to give slightly different responses. By this method, ascertain what level audio can be used before distortion begins to be noticeable. Back off about 8 or ten db and set this level as that which should be used for 100% modulation of the transmitter. (Severe distortion will occur before the assigned bandwidth is exceeded.)

Power Supply

The power transformer will necessarily be a heavy duty 500 volt TV type. (The final stage draws approximately 220 mils.) Check the current delivered by the genemotor and meet or exceed it with the power transformer used. To cut down heat, a bridge rectifier using RCA 1N1763 silicon diodes was used, as shown in Fig. 5. The completed unit should be compact so that the metal lid will fit back on the transmitter unit after completion. A handle is installed on top of the cover so that the transmitter is easily carried.

It is recommended that a small tube cooling fan be installed with the air stream directed across the 829B and additional vent openings cut in the sides of the case.

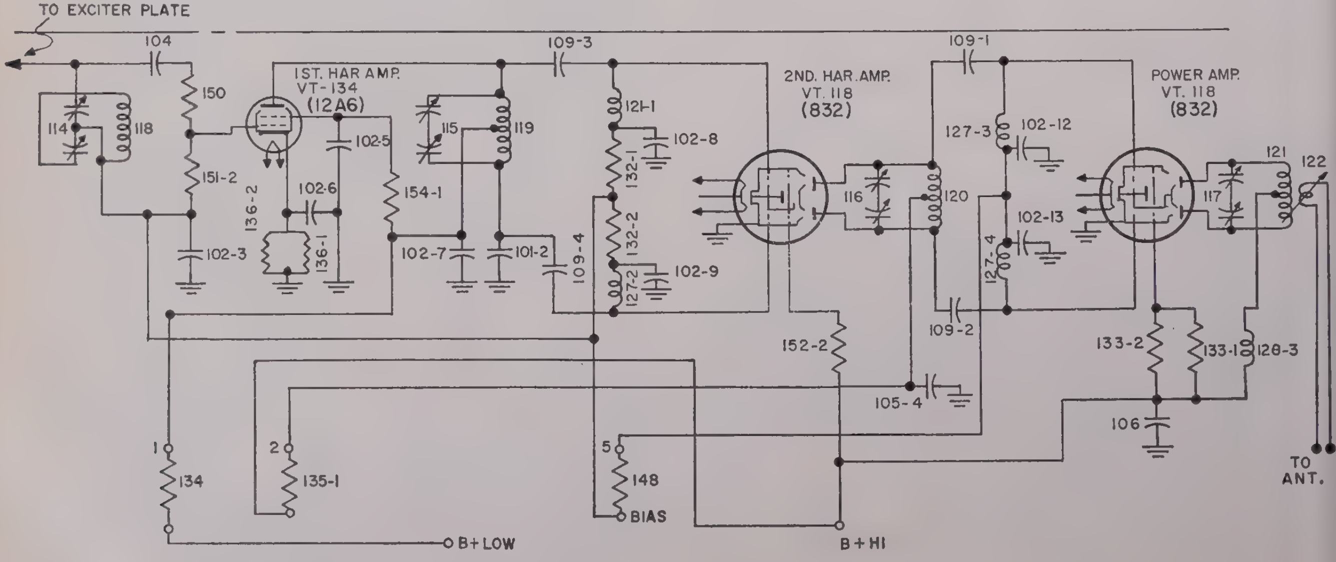

Fig. 7: Radio frequency section of the SCR 522 used for multiplier and amplifier. Multiplication is 18 times.

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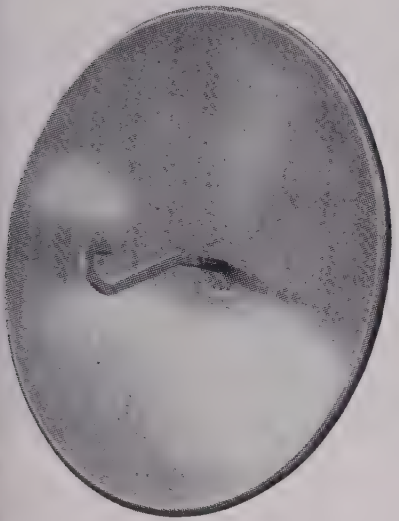

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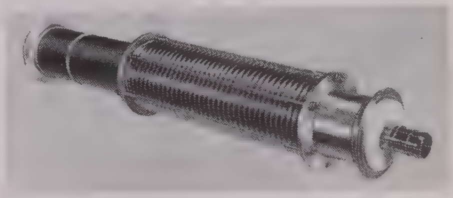

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Remote Pickup
(Concluded)

One thing should be remembered when converting this equipment. It was originally designed for intermittent duty, and unless precautions are taken to operate below original ratings or special cooling is employed, the life of the units will be materially decreased. Be sure that they are operated in open, ventilated locations, and where possible, drop the voltages applied to the tubes, along with the above suggestion for extra venting.

Other transmitter units, such as the Federal, Motorola and other Link models may be converted along the same lines as the above described conversion. It will always be necessary to install a better audio input transformer and a de-emphasis network between this and the grid of the modulator tube. Generally, it is preferable to remove the high gain audio preamplifier stages from the same chassis as the transmitter, although in one instance a low power transmitter complete with transistor mike preamp was built-up and has been used satisfactorily. This unit uses a single 2E26 as final, with a 12AV7 driver and a string of 6BJ6's as multipliers from a 400 KC crystal, phase modulated with the audio from a two-transistor amplifier. Since the mike nearly matched the transistor input circuit, it was unnecessary to use a hum-reducing mike-to-grid input transformer. Such a preamplifier is recommended for use with all of the transmitters described in this article. Such a circuit appeared in this magazine, prepared by this author. ("Build a Suitcase Studio," March 1960 issue.)

A satisfactory transmitter was constructed using the transmitter r-f lineup from a surplus SCR522 and a phase-modulated exciter such as shown in Fig. 4. Easily obtained r-f, i-f and TV coils were used for the tank circuits in the exciter along with a surplus crystal, slightly ground and calibrated (from a BC604 transmitter), in the 400 KC range. An ARC-5 r-f portion for the 100 to 170 MC range was also used. But it was found that this unit may possibly cause TVI from the plate chokes in the r-f stages. (The ARC-5 and SCR-522 are AM transmitters. In this case they were merely used as multipliers and amplifiers for the exciter.) The circuit used in the Gonset 2 meter Communicator makes a neat little r-f multiplier and final amplifier for such an exciter, but are a little tricky to get into operation with good efficiency on occasion.

Antennas

A portable antenna may be constructed of brass welding rods and mounted on a tripod or microphone stand. Use the charts in the "Radio Amateur's Handbook" to figure physical size. A four-element Yagi array is also easily made from brass rod obtainable at most hardware stores. The rods were mounted in a boom made of Reynolds "do-it-yourself" aluminum bars. The boom may be hinged in the middle so that it can be folded in half for easy transportation. We have mounted these units on the roofs of all the buildings from which remote pickups are regularly made, so that they are always ready for quick setups.

At the studios a 12-element receiving Yagi is mounted on a telephone pole with a TV rotator, which is controlled from the operating position in master control. This is an amateur antenna which has been cut down by 6% for use in the 150 MC band. Vertical polarization has been used simply to be compatible with the mobile unit whips. On some long hauls, horizontal polarization has been used with good results. This helps eliminate taxi and other similar interference.

In a following article, information will be given for receiver conversion or construction.

Special attention should be devoted to selection of the operating frequency. When issued, the license will read, "Subject to the condition that no harmful interference will be caused to industrial services in this band." It would therefore be wise to monitor the selected frequency for a few days to determine if there are industrial or emergency services operating in the immediate neighborhood.

Remote Broadcast Pickup Stations are licensed only to presently licensed AM, FM or TV stations. These may be AM or FM and shall observe a frequency tolerance of at least 0.005%. Frequencies assigned for this use include: 152.87, 152.93, 152.99, 153.05, 153.11, 153.17, 153.23, 153.29, 153.35, and 166.25 and 170.15 MC under special conditions, listed under subpart D, sections 4.401 through 4.482, of the F.C.C. Rules and Regulations. There is a proposal presently before the F.C.C. to grant a set of frequencies slightly higher than the above for use by radio stations as Remote Broadcast Pickup Stations exclusively.

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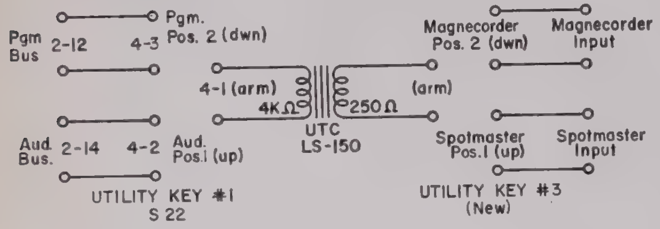
Tape Recorder Switching Circuit

LAWRENCE L. PRADO, JR., Ch. Eng.

WPEP, Taunton, Mass.

Owners of the Gates SA-40 console and other similar units who are using my special tape recording circuit published in *Electronic Industries*, November, 1953, may find the following circuit modifications extremely helpful.



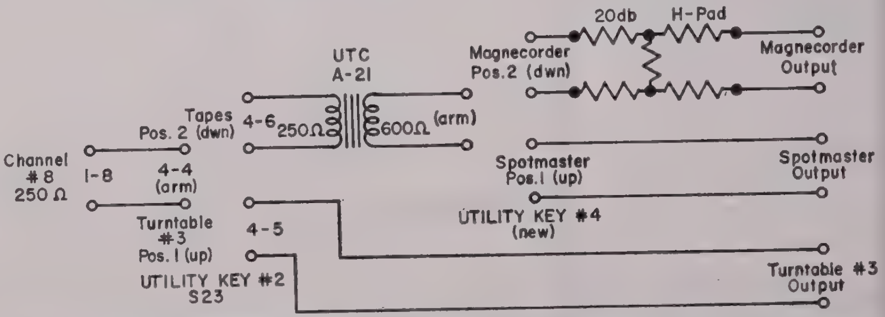
WPEP recently purchased the Spotmaster 500, a combination playback and recording cartridge type recorder. The same problem existed installation-wise with this new unit, as existed a few years ago, when we desired to feed a rack mounted tape recorder into the Gates SA-40 console. However, the problem was more acute this time because we had used Channel 8, and still continue to do so, for both a turntable and a tape recorder input. We wanted to retain the present circuit as much as possible to provide normal operation. However, it was just as necessary to provide input and output circuits for the Spotmaster with a minimum of confusion for the operators.

By means of two additional utility keys mounted on the SA-40 console, in line with the present keys and inter-connecting cables, the original circuit is retained with slight modifications. Actually, greater flexibility was obtained with the modifications. We can air a regular tape recorded program with the rack mounted Magnecorder or use number 3 turntable. At the same time we can tape a commercial from the audition bus into the Spotmaster.

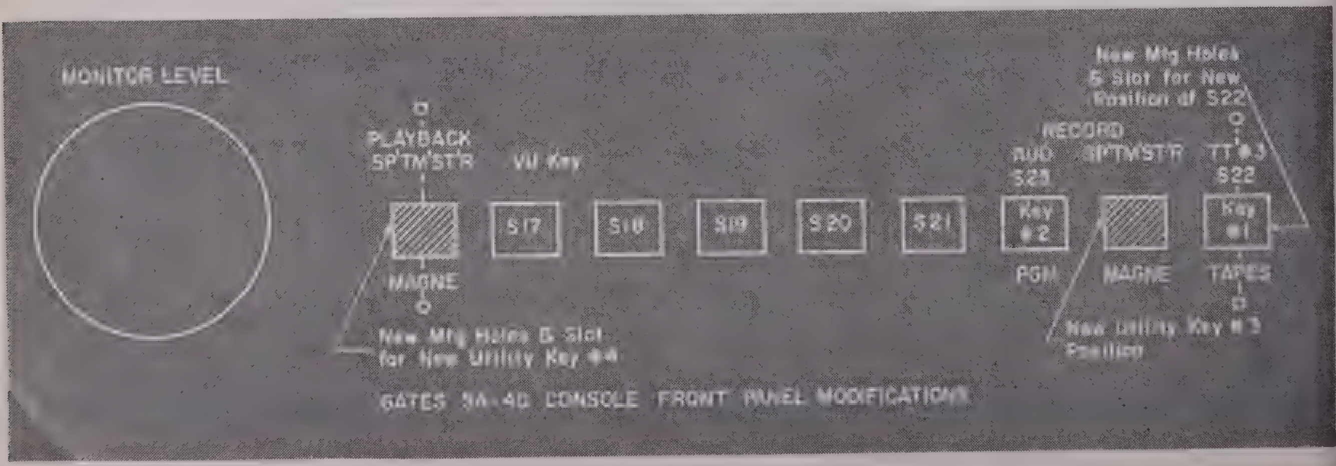
It will become apparent at once that the reverse is also possible; to air a commercial with the Spotmaster, while recording with the rack mounted Magnecorder.

The original circuit is shown along with the modifications for Spotmaster use. It is necessary to retain the line-to-line transformer in the input to Channel 8 because of the unbalanced output on the Spotmaster. Where the output of the Spotmaster is quite low, −15 db, the 20 db attenuating pad in the original circuit is re-wired to include only the rack mounted Magnecorder. Ample gain is obtained from the Spotmaster by direct feeding through the line-to-line transformer for isolation. It can be reduced by means of a control on the Spotmaster.

The input circuit requires little change, other than the insertion of a lever-type switch to feed audio from the program or audition bus into the proper tape recorder. Both switches are two-pole, 3-position types, with the center position being off. The usual wiring precautions should be observed; plastic or fabric covered shielded wire and as much separation between input and output leads and switches as possible. Original SA-40 console terminal board numbers, utility switch numbers and positions are indicated, along with the new utility switches and positions.



Two new mounting slots and holes are drilled into SA-40 console front panel. Utility Key #1 (S22), is moved over one place to new mounting hole, internal console wiring has enough slack to permit this change. New Utility Key #3 is installed in former position of S22 to make wiring between UTC LS-150 transformer (mtg under console), and keys 2 and 3 easier. New Utility Key #4 is installed next to VU key at extreme left for proper playback switching. This also permits easier wiring between UTC A-21 transformer, TB4-6 and Key #4 arm.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S20
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Key #2
Key #1
PGM
MAGNE
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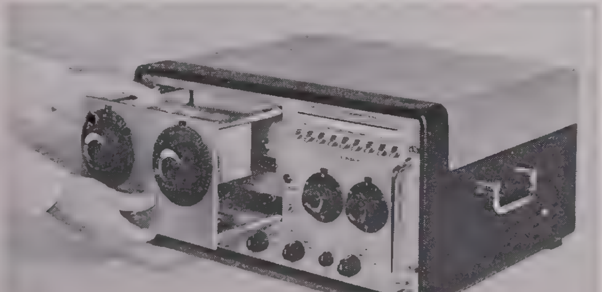
A Sweep/Signal Generator for Audio to 3000 MC

As a major designer and manufacturer of RF instruments and components, Telonic once again leads the field with the introduction of the SM-2000 Sweep and CW Signal Generator. New from every standpoint, the SM-2000 provides unmatched versatility for laboratory or production operations. Now, with **one instrument** and several, interchangeable plug-in oscillators, an engineer can cover a frequency range from audio to 3000 mc.



Telonic has designed 19 different oscillator heads for specific and general purposes that enable the user to change range of the SM-2000 in a matter of seconds. For general applications, only two plug-in units are necessary to cover frequencies from .5 to 2000 mc. And, in addition, the operator may select four different functional modes with the SM-2000—swept RF, modulated swept RF, CW, and modulated CW. He can set attenuation from 0 to 60 db in 1 db steps with the two built-in attenuators. He also has provisions in the instrument for use of an external marker, or for adding up to eight fixed, plug-in markers if desired.

All these features are combined with the fine basic performance that has made the name Telonic synonymous with the best in RF instrumentation—low VSWR, high display linearity and excellent workmanship. If you would like more complete details on this new sweep generator please write for Technical Bulletin T-233.

Telonic Industries, Inc.
BEECH GROVE, INDIANA—PHONE STATE 7-7241

Circle 95 on Inquiry Card

WASHINGTON News Letter

NASA-AT&T CONTRACT—The most concrete progress in the efforts to have the U. S. first in space communications has been achieved by National Aeronautics & Space Administration and American Telephone & Telegraph Co. AT&T, under an agreement for development and testing of an experimental communications satellite system will defray the government's "incremental" cost of launching and associated operations. It is estimated that the cost of government services to AT&T will be about $6 million for each launch. AT&T will "design and build the satellite at its own expense." Launches are scheduled for April and October of next year, and if backup launches are required they will be held in June and December, 1962.

PATENT PROVISIONS—NASA announced that the Government will receive a royalty-free license for all patentable inventions developed as a result of the space system experiments. Under the patent provisions, the NASA administrator receives the right to issue royalty-free licenses to others on such terms as he may decide. The patent provisions go beyond all patentable inventions developed as a result of the experiment and cover any other Bell System inventions, not directly resulting from the satellite test, insofar as they may be used in satellite communication. This covers, it was cited by the NASA general counsel, already-invented components which will be tested in the program and those invented up to December 15, 1962, the end of the contract.

NATIONAL POLICY—President Kennedy outlined a national policy favoring private ownership and operation of a satellite communications system which has been recommended to him by the National Aeronautics & Space Council. Policy guidelines specified non-discriminatory use of and access to the system by authorized communications companies, competitive bidding for equipment, and an ownership structure assuring maximum competition. The President stated that "the present status of a communications satellite program, both civil and military, is that of research and development." He added that "to date, no arrangements between the government and private industry contain any commitments as to an operational system."

201
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IMMEDIATE OFF-THE-SHELF DELIVERY...
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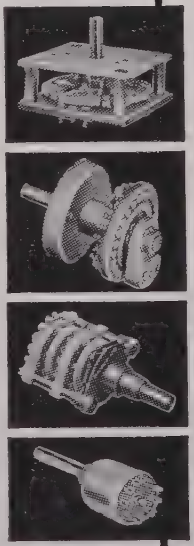

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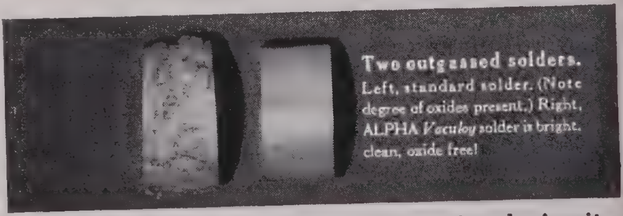
Circle 129 on Inquiry Card

NEW solder discovery!



Two outgassed solders. Left, standard solder. (Note degree of oxides present.) Right, ALPHA *Vaculoy* solder is bright, clean, oxide free!

ALPHA *Vaculoy*® bar solder cuts printed circuit joint rejects from 1-in-50 to 1-in-5,000. No other solder does this because no other is *made* this way!

Above is an unretouched photograph of two solder specimens—both outgassed. Left, is a *standard* printed circuit solder. Note presence of impurities on surface—a sure sign of undesirable oxides. Right, is ALPHA *Vaculoy*.* Its bright, clear surface indicates freedom from oxide-forming elements. Result? ALPHA *Vaculoy* bar solder cuts dross, improves wetting, produces brighter connections, increases bath life, reduces inherent inclusions and insures reliable electrical connections. Meets Fed. Specs. QQS-571C. Get all the facts. *Write for data today!*

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Circle 130 on Inquiry Card

PROCEED WITH PROMPTNESS—It was stressed by the nation's chief executive that the development of the new space communications technology "proceed with all possible progress" so as to "bring the farthest corner of the globe within reach by voice and visible communications, fairly and equitably available for use." After President Kennedy's issuance of his national satellite communications policy, the AT&T commented that "now private enterprise can go ahead full speed to put up the worldwide space communications system envisioned by the President."

1961 TV PRODUCTION AND CENSUS—TV production and sales increased this year and a shortage of sets may occur this fall, according to the Electronic Industries Consumer Products Division. It noted that retail TV sales are more than 8 million sets ahead of last year for the first half of 1961. The Census Bureau announced that its finding for 1960 showed that 86% of the 53 million households in the United States had at least one TV set. This conformed with a survey by the National Broadcasting Co. which recorded 87.1% of the households with TV.

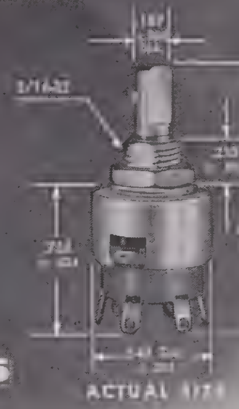
SPECTRUM STUDY—The FCC has agreed that a continuing study of the management and allocation of the radio frequency spectrum is desirable and should be "undertaken as promptly as possible." This has been urged by ELECTRONIC INDUSTRIES for years. This commitment in a statement by the FCC, read by Chairman Newton N. Minow, was made to the Senate Commerce Communications Subcommittee at its recent hearing on satellite communications. The Commission statement declared that the IRAC for government and the FCC for civilian frequencies should immediately undertake the study of overall allocations policies, and that "it would also be helpful" if the two authorities called upon distinguished and experienced outside advisers as advisory committees or technical studies by contract.

National Press Building
Washington 4

ROLAND C. DAVIES

ENGINEER-SCIENTISTS of ITT Corp. took a long look at global communications and predicted that communication satellites of the future and existing cable networks will play a complementary role. Satellites that will handle the communications requirements of the hemisphere of the earth containing North America, Europe, South America and Africa should have a minimum capacity of 1,000 telephone channels and will service 50 ground stations. The maximum number of inputs would be equal in number of ground stations, namely 50.

NEW
Midget Rotary
Tap Switch



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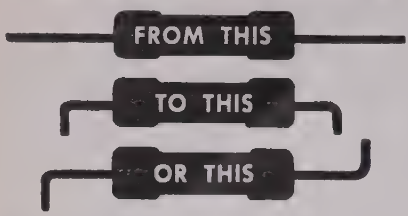

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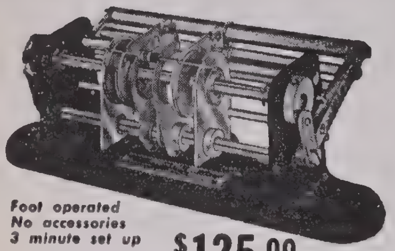

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Circle 133 on Inquiry Card

Teflon

(*Continued from page* 117)

density throughout the entire cross section.

Specifications

Teflon has solved many problems in many industries, never before solvable; has obsoleted many inferior products; and, has traced a wide horizontal path through most industries in this country and abroad. But its real broad future has not even come into focus. Thousands of uses are still to be uncovered, and most certainly will be uncovered as more product designers begin to design with Teflon in mind. Here are the specs for Teflon.

Mechanical properties: Low coefficient of friction; extreme toughness, flexibility and fatigue resistance. Excellent molecular memory. Some degree of elasticity.

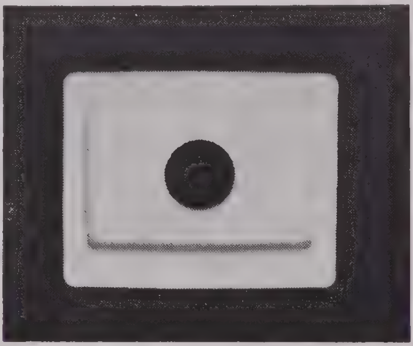


Fig. 6: This part was molded with 2 of the required tolerances to size; then other tolerances—recessed area—were machined.

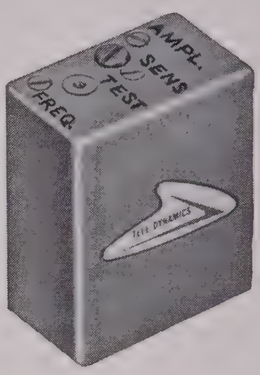
Electrical properties: Excellent; remain stable to +400°F. Power factor—less than 0.003 from 60 cps to 30,000 MC. Surface resistivity—3.6 x 10^6 ohm cm. High dielectric strengths varying with thickness. Good arc resistance.

Thermal properties: Maintains flexibility, toughness and strength over temperature range from −450°F to +500°F. Non-flammable, no melting point, low "K" factor, high coefficient of expansion.

Chemical properties: Resists effects of all chemicals—even in boiling acids—with the exception of only fluorine, chlorine trifluoride, or molten alkali metals at extreme pressure.

TELEMETRY BY TELE-DYNAMICS

Voltage Controlled Oscillator



Positive, reliable oscillator performance is essential to your aerospace telemetry needs. And Tele-Dynamic's newest—the Type 1270A Voltage-Controlled Oscillator is representative of Tele-Dynamic's creative effort in the complete telemetry field.

Characterized by excellent overall specifications, this new oscillator is high in electrical performance and environmental characteristics. Input 0 to 5 volts or ± 2.5 volts, linearity ± 0.25% best straight line . . . a power requirement of 28 volts at 9 milliamps maximum. Distortion is 1% and amplitude modulation 10%.

Environmental characteristics include thermal stability of ± 1.5% design bandwidth from —20°C to +85°C, unlimited altitude, 30G random vibration and 100G acceleration and shock. The 1270A weighs less than two ounces and has a volume of two cubic inches.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone TRinity 8-3000.

8411

TELE-DYNAMICS
DIVISION
AMERICAN BOSCH ARMA CORPORATION
5000 Parkside Ave., Philadelphia 31, Pa.

Circle 134 on Inquiry Card

Troops Use IR Device For Night Operations

A hand-held infrared viewing device (called Metascope) which enables combat troops operating in total darkness to see without being seen, has been developed by Varo Inc. of Garland, Tex., in conjunction with the U. S. Army Engineer Research and Development Laboratory, Fort Belvoir, Va.

The infrared flashlight on the Metascope projects a beam of infrared light, which although invisible to the human eye, is easily detected by the Metascope. A soldier looking through the device sees objects illuminated by the infrared beam as though he were using a standard flashlight.

Transistorized Metascope replaces a larger and heavier unit with a hand cranked power supply. The new Metascope weighs less than three pounds and utilizes a single 1.3 volt battery as the power source.

Small Electronics Firm Has Vital Defense Role

The small electronics firm is contributing heavily to national defense, and its role should expand considerably in the near future, according to Nathan Pinsley, president of Espey Mfg. & Electronics Corp.

"There is increasing emphasis on strengthening our nation's defense as the cold war shows no signs of slackness," he said. "This will be reflected in new contracts let by the military, additional governmental spending, and inevitably, a heavier workload for defense industries, with the small electronics firm sharing in this increase."

Mr. Pinsley described the small electronics firms as "unsung workhorse of the industry," and pointed out that it was heavily engaged in a wide variety of defense work at the present time. "The electronics industry today is a highly complicated and complex business, and as product refinement and miniaturization proceed, our problems are expected to increase," he said.

He noted the smooth and successful transition made by numerous small firms from radio and hi-fi phonograph production to the complexities of missile and rocket work, and foresaw no reason why small firms should not continue to prosper.

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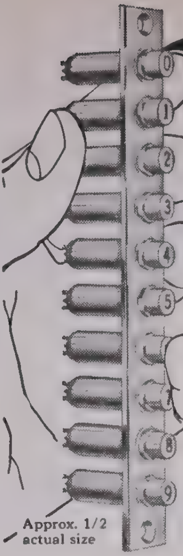

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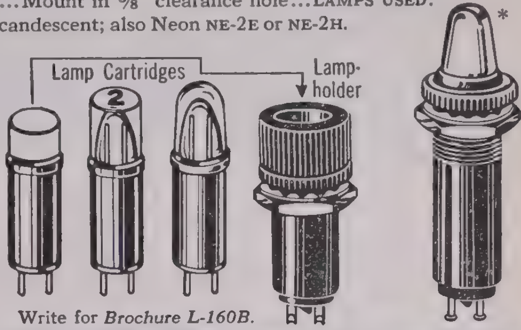

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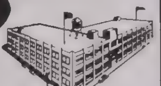

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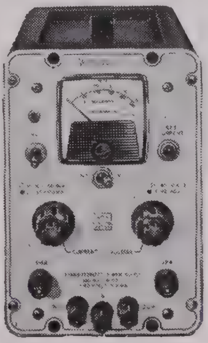

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National*... RESEARCH

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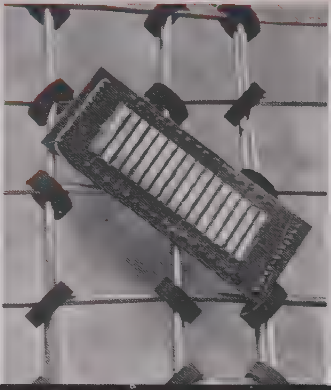
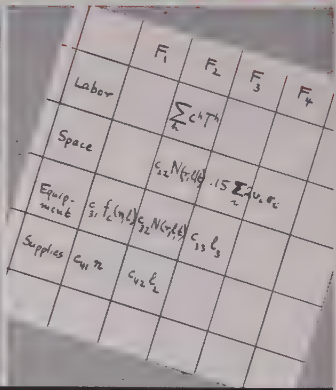


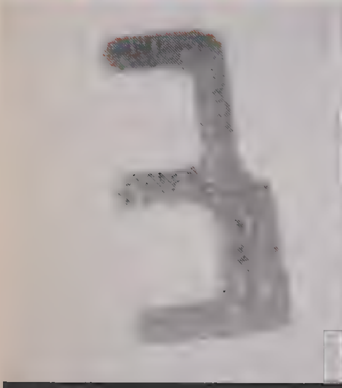
MAGNETICS

THIN FILMS



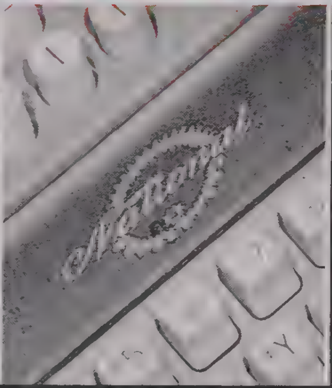
OPERATIONS RESEARCH

and... DEVELOPMENT



OPTICS

LOGIC & CIRCUITRY



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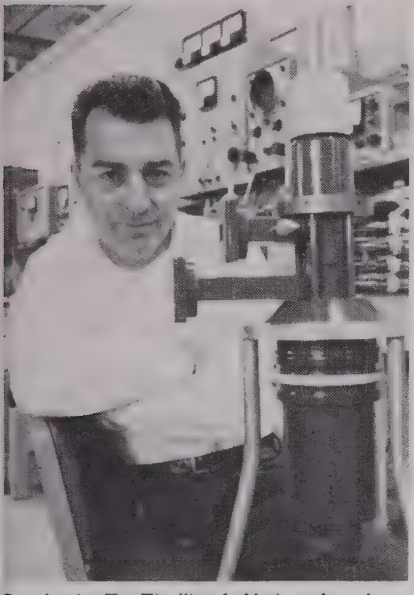
ACHIEVEMENT AWARD



Dr. Louis T. Zitelli of Varian Associates, Palo Alto, Calif. is shown with the VA-849 klystron amplifier. Development of the VA-849 won Dr. Zitelli the 1961 Seventh Region I.R.E. Electronic Achievement Award. The award committee cited the tube as "a major breakthrough in the achievement of high power in the microwave range."

Scientists Cited For Reducing Radio Noise

Two scientists, inventors of a three-level solid state maser responsible for the reduction of noise in communication systems ranging from telephones to receiving stations for satellites, will be awarded Stuart Ballantine Medals by the Franklin Institute of Phila.

Dr. N. Bloembergen, Harvard University Professor, and Dr. H. E. D. Scovil, Bell Telephone Laboratories Engineer will receive their awards at formal Franklin Institute ceremonies. The medal is being awarded "for the invention of the three-level solid state maser and its subsequent development for practical use."

The Stuart Ballantine Medal founded in 1946 by the Boonton Foundation, is awarded for outstanding achievement in fields of communications which employ electromagnetic radiation.

Stock Options to Key Employees Needed to Stimulate Small Businesses

Small service businesses cannot survive without offering a stake in the business to their key employees, according to Herbert W. Robinson, president of C-E-I-R, Inc., N. Y.

Dr. Robinson testified before the Senate Finance Committee in its hearings on the proposal of Sen. Albert Gore to amend the Internal Revenue Code to eliminate the provision which now permits companies to issue options to their employees to purchase stock in the employing company at from 85% to 110% of market value on the date the option is granted.

Dr. Robinson maintained that small companies like C-E-I-R could not compete with the large and well established companies in the U. S. for the vital but scarce talent necessary to the success of small businesses were it not for the provision making practicable the issuance of stock options to employees.

He pointed out that, "eliminating employee stock options would, in fact, tend once again to promote the concentration of significant stock ownership and control in the hands of the wealthy. . . . Only through the even greater use of employee stock options can a real stake be given to the many professional and executive employees on whom the success of most businesses (and the very survival of this country) increasingly depends in this era of technological advances."

National Science Foundation Grants

Grants totaling nearly $1,500,000 were recently made to 248 colleges and universities by the National Science Foundation. They were the first grants made by the Foundation under its Institutional Grants Programs.

Institutional grants are designed to strengthen the over-all scientific research and research-training effort. They provide colleges and universities with valuable flexibility for strengthening and balancing scientific research activities without specifying the particular activities to be undertaken with the funds. Those receiving grants report to the Foundation each year on use of the funds.

Guide for Business

Guidelines small firms can follow in building a sound reputation and developing the right public image of their products and services, are contained in a new leaflet called "Building the Right Reputation." It is number 69 in the Small Business Administration's Marketers Aid series, and can be obtained from all SBA offices.

RECRUITMENT PROGRAM

Forming a giant N are some of the 39 junior engineers who have joined United Aircraft Corp.'s Norden Div. in Norwalk, Conn. as a result of the 1960-61 college recruitment program. At right foreground is Frank Preston, Norden's chief engineer.

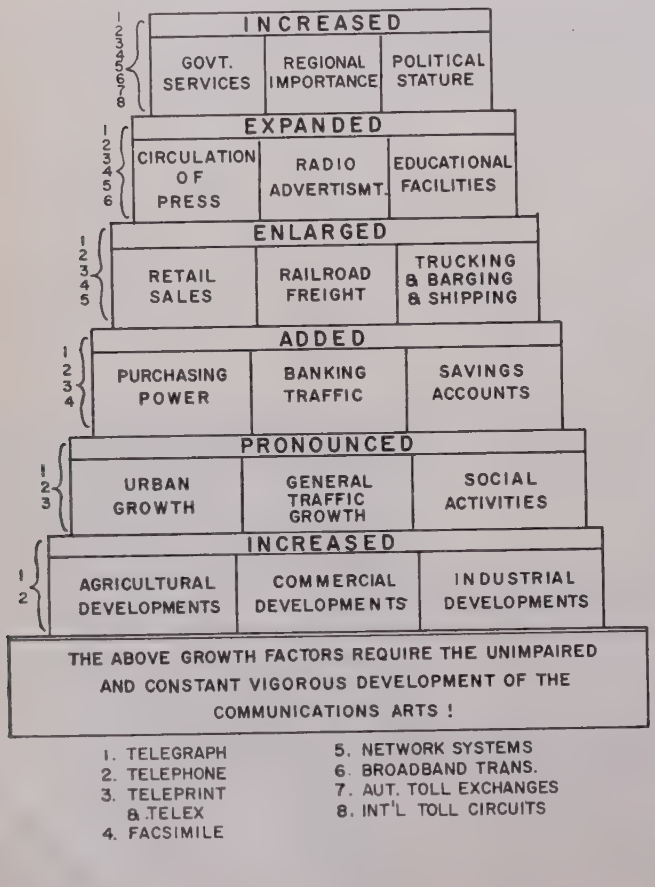
FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 195.

By Dr. Walter J. Duschinsky
Telecommunications Management Consultant

Latin American

LATELY there have appeared a number of articles concerned with South and Central American Telecommunications. But there has been little or nothing said about the basic problem involved and the underlying reasons for the delayed communications development of the Latin American Hemisphere. In this short article the discussion centers around one simple aspect of this complex polemics.

Of the underlying difficulties which confront the communications planner studying the needs of any Latin American country, the lack of a coordinating agency or authority is the most pronounced. While there usually are governmental organs charged with the task to regulate the communications field, de facto none operates as such; they do not represent a centralized or unified agency which controls, registers, directs, investigates, monitors, or even has knowledge of most of the telecommunications activities of their respective nations. The person in charge of the National Communications Services is either known as the Director of Communications or the Chief Engineer of State Communications, placed under the direct authority of the President's office, the Minister of Interior, or the Minister of Public Works. His department—which theoretically must deal with the registration and allocation of the national frequencies, the granting of licenses to the different types of public communications services, to common carrier companies—telegraphic as well as voice—telephone, the franchising of radio broadcasting and television stations, the coordination of public communications with those instrumentalities operated by the Security and Armed Forces and the monitoring of all these communications—usually consists of himself and a handful of engineers and draftsmen. The improbability of accomplishing this complex task is further impeded by the absence of realistic operating funds for use of the department.



The fact that, in most instances the local telephone companies are owned and operated by foreign enterprises, although they may have local management, creates additional complications. In the majority of cases the larger metropolitan telephone companies in South and Central America are the property of the IT&T. While German and Swedish companies such as Ericsson and Siemes own or finance smaller entities, these companies are operating often without proper licenses or franchises and in respect to IT&T owned companies, their policy is directed by IT&T headquarters in New York. Operating permissions and licenses are usually not issued by the National Government of the State authorities, but are by courtesy of the local prefect or the town-council. The Director of National Communications has little effective control over these companies and indeed nothing to say in respect to the improvement and modernization of their services, the replacement of over-aged equipment or their distribution systems. If he takes action against a company in case they do not follow some of the rare directive orders of his office, the companies can disregard such without fear of consequences. Many Districts and States have a number of telephone companies owned by different groups, operating with diverse equipment and often incompatible standards. Transmission systems for any types of service in existence, such as Voice-telephone, Morse Telegraphy, teletype, and the few Telex circuits, are usually con-

Lack of a central coordinating agency leads to situations where a multitude of mediocre transmission systems are running parallel to each other in one area, while other areas are totally lacking in communications.

Communications Planning

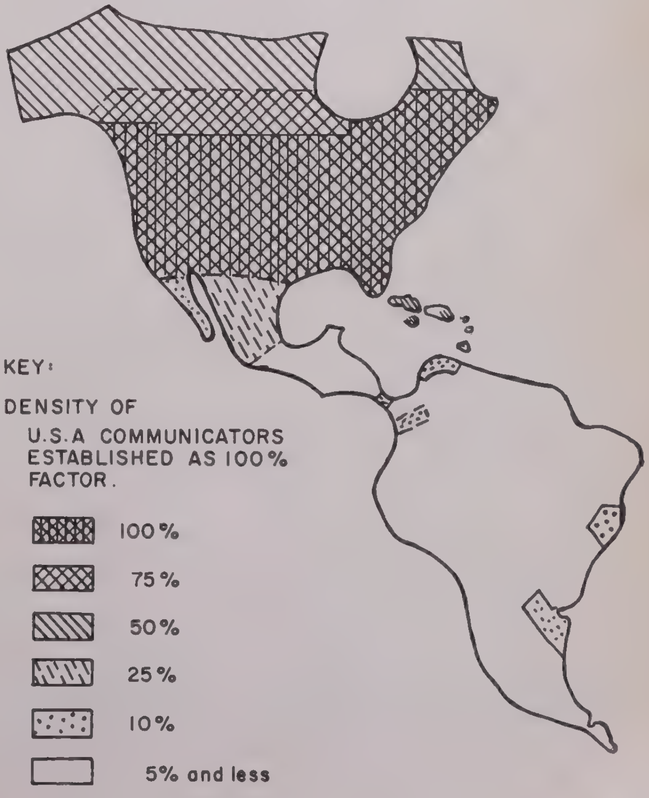
ducted over antiquated and badly maintained open wirelines, providing usually one or two circuits and connecting with terminal equipment which is in the majority of instances of a manually operated type. Some of this exchange equipment is 40 to 45 years old, and more often than not has been cannibalized in order to keep it in operation. We may find, that a city which in 1945 had 19,000 telephone line exchanges serving its 500,000 inhabitants, showed in 1960 for an increased population of approximately 750,000 only 17,000 lines in operation. In addition, the condition of the city's distribution systems are such that the low quality of the overhead open wireline or cable system, often using loose rooftop connections as the supporting medium for its iron wire lines.

The national telegraph system in most of the South American countries is operated by Postal and Telegraph authorities, which are not under the jurisdiction of the Director of Communications. Again separate open wirelines of both bad quality and bad routing are employed. It is nothing extraordinary to find that in Brazil a telegram dispatched from Porto-Alegre to Curitiba, a distance of about 350 miles, needs from two to three days to reach its destination. The use of Morse Telegraphy is still common, with modern teletype machines and automatic teletype centers practically unknown. With few exceptions, national Telex routes for all practical purposes do not exist. Overseas cables sent from an inland point may arrive either days later or never at their destination. Some of the writers' cables from Tucuman (Argentine) never reached Houston, Texas. International Cable Carriers using as international transmission media, submarine cables or radio telegraphic HF circuits are prevented to build or operate their own cable or radio relay links with their landing points. In some instances they are more than 100 miles apart from the main office of the company, usually located in the Capital of the State. These companies are, therefore, forced to use the governmental post and telegraph department lines, which in some instances for practical purposes have been maintained by the foreign carriers themselves. But these cable companies are not permitted to make improvements on the line or substitute old equipment with their own modern apparatus. Any request for action by a foreign cable company to the Director of Communications is usually cold shouldered, as the Postal and Telegraph authorities consider themselves competitors in the international cable field and will block any action of the Communications Department. This is usually accomplished by applying political pressure at the Presidential Governor's level.

What for the uninitiated appears to be an extraordinary factor is to find a multitude of mediocre transmission systems running parallel often over considerable distances; because each Government Department considers communications its own domain. One may find the open wire system of a Nationally owned railroad which is modernized by connecting through a single channel VHF relay with an outlaying but important dispatching center. Over the same path an Army Signal Corps open wireline may run a few hundred yard or so apart to the same destination.

Studying the existing South American HF Communications, the problem appears to be to find "who" is "what" operating. Practically everyone of the larger buildings in the capital cities carries an imposing

Measured by U. S. standards the communications in Latin America are woefully inadequate



Latin American Communications *(Concluded)*

array of antennae; in fact, some large rhombics may extend over the rooftops of two city blocks. Single-side-band operation is growing and becoming a new mode in the commercial and industrial operation; those businessmen and industrialists who have given up requesting the Government to provide them with a reliable common-carrier-owned system and decided to have their own communications to interconnect their plant or office facilities, now install SSB systems. Practically all airlines operate their own navigational and communications networks. As a rule, these airline communications systems and repair shop facilities are better equipped, organized, and operated than any of that of the Government. Varig Airline has, at its home base in Porto-Alegre, a fully equipped electronics workshop which may be quoted as a typical example of well-designed, well organized, and well-managed installation, able to take care of the maintenance of such sophisticated equipment as the Boeing Jet Auto Pilot, Radar, and its complex radio navigational and communications apparatus.

The Director of National Communications in most South American countries finds itself with the barest of instrumentalities, such as test and monitoring equipment. With the few funds available, he usually is only authorized to purchase "National" electronic products which, without exception, are below the standards of the U. S. or other foreign products and certainly not in accordance with the recommendations for such apparatus as specified by the CCITT, CCIR, or CCIF. His scant library is lacking literature concerned with the later technological development, and all he may possess, are these folders of proposals, which source of communications equipment manufacturers may forward, in the hope that they receive at some future date, equipment orders. The equipment suggested in these proposals often represent equipment which the same manufacturer would not dare to offer to the well-informed communications engineer in more advanced countries. The number of South American engineers really qualified to make decisions concerning modern systems and equipment is indeed restricted. Their training at the local universities or trade schools is lacking in depth and the intimate understanding of the latest technological advances cannot be provided for. We must add to this, the few opportunities the South American Communications engineer has to work with modern equipment and this may clarify the picture when an analysis of the local situation indicates that Communications Planning, as a general rule, is far behind in all these actions. The rare exceptions are usually the military communications engineers, trained either by the U. S. or European Armed Forces Communications Schools, where they have an opportunity to operate modern equipment, observe contemporary standards, and the high efficiency type of maintenance and service. But again, unfavorable economical conditions in South America hinders full utilization of such trained manpower. Once these specialists retire from their military service and enter the civilian life, they usually join the different foreign communications companies, for higher pay and larger opportunities, as their Government cannot offer them adequate salaries and governmental positions. These men become in time, nothing more than glorified sales engineers, representing foreign companies and, therefore, a loss to the engineering community of their respective country.

These are some of the hard facts the communications planner faces when working in Latin America, analyzing and evaluating national telecommunications projects.

Interest in Science Often Develops Early

About half of the nation's potential supply of scientists have started to develop as scientific thinkers and doers by the time they are fifth-graders according to Science Service. Continuing studies have shown that many very young scholars take to science as naturally as they wade into a mud puddle.

This year more and more requests for information and advice on conducting elementary and junior science fairs have been received at National Science Fair-International headquarters at Science Service in Washington, D. C. The science fair program continues to spread rapidly from senior to junior high schools, and then through the elementary grades even to nursery school.

A cumulative Science Service study of 1,306 finalists at the annual National Science Fairs revealed that 90% of these potential scientists were oriented toward science before they had been introduced to high school courses in physics, chemistry, biology and mathematics. About 13% of the total group started out at twelve years of age, or seventh grade.

Science Service studies also revealed factors which were responsible for the enthusiastic response to science shown by the 1,306 junior scientists.

More than one-third said that school activities, courses laboratories and teachers were most directly influential. One-fourth were started at home by family members, family activities, attitudes and expeditions. Self-generated drive launched 12.2%, who described irresistible curiosity as their prime movers. Interest of 10.5% was captured by science equipment that provided opportunities to explore for themselves. Reading started 7.7%. Science clubs and science fairs were responsible for the interest shown by 6.1% and the final 4.6% reported a miscellany of things such as museums, National Parks, television programs, planetarium programs, etc.

MINIATURE TV CAMERA

Pocket size camera, small enough to scan the inside of a 3 inch pipe, is known as the Minicamera. Small size has been achieved by placing only essential components in the camera itself. Others are housed in a separate unit. Equipment is marketed exclusively in the U. S. by the Electronics Div. of Fairbanks, Morse & Co., Yonkers, N. Y., under special arrangements with EMI Electronics, Ltd.

FROM THE GENERAL ELECTRIC COMPANY

6 answers—with some long-range meaning for Engineering Writers

Q Is this message published in an effort to hire Engineering Writers? If so, does it also include Technical Writers?

A **Yes, General Electric has openings for professional Engineering Writers in its Heavy Military Electronics Department. Most of these are new openings, based on Department growth. But while inquiries from Technical Writers would be welcome, these particular openings are for Engineering Writers only.**

Q So there is no misunderstanding, will you pinpoint the difference between the Engineering Writer and the Technical Writer in your organization?

A **It is in the degree of technical competence required. In our organization, the Engineering Writer is a professional in the full sense of the word—with a technical competence approaching that of the Design Engineer with whom he so closely works. HMED's Engineering Writers either have their BSEE's or the equivalent in experience and training.**

Q What is the nature of the work?

A **If qualified, you'll be assigned to one of the major electronic systems programs for which the Department is responsible. For example, you might be assigned to the Navy SQS-26 program—involving the most powerful shipborne sonar in the free world. Or it could be to a project designed to monitor all activity in millions of cubic miles of ocean. And these are but two . . . .**

Q What functions are involved?

A **You'll be providing the first "translation" of the raw material (i.e. graphs, schematics, charts, etc.) produced by the Design Engineer into manuscript form. From your manuscript and under your direction, support personnel provide publications covering systems philosophy, installation, operation, and maintenance for use by military customers.**

Technical competence is the vital qualification here. Certainly your writing talent is valuable, but in terms of major electronic systems—we need your technical competence. That's why even though you have responsibility from start to printed material, your support personnel take care of finished writing, illustrating, and printing.

Q What are the qualifications?

A **You could be qualified in either of two ways:**

1. If you have your BSEE and experience in our product line, you are probably qualified.

2. But we would also strongly consider an E.C.P.D.—accredited Technical School graduate or a man with two or more years' credit toward his BSEE. But in this case, you must have also had the following military experience:

2 or more years' maintenance or repair of major electronic systems, specifically radar (land-based or shipborne), computers (fire control or GCI), or sonar.

Q Assuming I qualify, would it really be worth a job change?

A **Yes—if you are looking for greater professional opportunity. In the first place, you'll be treated (and expected to contribute) at a high level. Also, you'll be joining an organization within G.E. that continues to grow. The technical writing staff has grown by 700% in the last eight years and there is no let-up in sight. Obviously, this means you are joining a Department that needs your talent—and the need will continue into the foreseeable future.**

More information about General Electric's extensive benefits program is available upon request. Relocation assistance will be provided. Qualified personnel will be invited to Syracuse for interviews at Company expense. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. 178-01

FOR MORE INFORMATION, *send a summary of your background and experience in confidence to:*

Mr. George B. Callender
Engineering Administration, Section T-6
Heavy Military Electronics Department
General Electric Company
Court Street, Syracuse, N. Y.

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Circle 804 on "Opportunities" Inquiry Card

Checklist for Marketing a New Product

Here is a list of questions that you should answer before marketing a new product.

Number of Users

- What industries will use the new product? List those that first occur to you.
- Does your product have any possibilities for consumer use?
- Can you count on selling any of your product to the Federal Government, including the Armed Forces?
- Can you count on its being used by State and local governments?
- How many potential customers are there in this country? List every use that you and your friends and associates can think of. Then on the basis of the United States Census of Manufacturers, manufacturers' registers, and other sources such as Chilton's Marketing Assistance Program estimate the number of prospects, either firms or individuals, for each type of user.
- What factors cut down the size of the total market?
  Does the computation of potential customers include deductions for sections of the country where there is little use for the product?
- What percentage will be poor prospects because they use smaller-scale or larger-scale equipment than your product? (For example, small banks would not need large computing systems.)
- What percentage is likely to be out of the market because potential users already have similar products giving satisfactory services?
- What other market-limiting factors, if any, are peculiar to the nature of your product, and roughly, by what further percentages might they reduce the size of your total market?
- Is the market for your type of product likely to increase or decrease in size during the next 2, 5, or 10 years?
- Are there foreign sales possibilities for your product? (If so, you may wish to estimate the number of prospects in various foreign countries. The Department of Commerce can give you much useful information on these foreign prospects. In most cases, however, you probably will restrict sales to the domestic market before branching out abroad.)

Users' Buying Habits

- Ho do users generally pay for such products? For cash? On open-account credit? On a time-payment plan?
- Will your product sell evenly throughout the year or will the bulk of the sales be concentrated in one or more seasons as with fans and air conditioners.
- If seasonal:
  - When will your immediate customers buy?
  - If your customers are not the final users, when will the users buy?
  - Is there any way to level out seasonal fluctuations in sales by balancing sales to different groups of purchasers?
  - Are purchasers of this type of product accustomed to buying it ahead of need or do they tend to place spot orders for instant shipment? Are you prepared to give dated billings to seasonal buyers?
- Will some purchasers of your new product buy only on the basis of unusual technical specifications or other special buying procedures? If so, can you meet their requirements?
- Are the potential users of your product accustomed to relying on trade names or firm names, or do they buy mainly on the basis of technical specifications?
- How do major users or distributors of the product negotiate for it?

Distribution

- Briefly, in what parts of the country are the prospects you want to reach?
- How, if at all, does the location of your prospects affect your plans for distribution channels?
- Have you considered the possibility that it might pay you, for a preliminiary trial period, to confine distribution of your product to one or a few selected regions of the country?
- Through what channel or channels are users accustomed to buying products of this kind?
- Put this question to yourself and your friends and associates: If you were going to buy a product of this type, from what outlets would you prefer to make your purchase?
- What channel or channels do you actually plan to use?
- If you plan to distribute the product in a manner unlike the way similar products are now usually distributed, or unlike the way you would prefer to buy the product if you were in the user's shoes, are you sure there are valid reasons for your decision?
- On what sort of franchise, if any, do your competitors usually sell products like your new product?
- What do you expect to do about the franchise matter?
- If products like your new one usualy halve a service guarantee (either a factory guarantee or a distributor guarantee) will you and your distributors conform?
- If products like your are usually installed by the manufacturer or distributor, will you and your distributors conform?
- Have you considered the best way of getting your product to your customers? Have you studied alternative carriers from the point of view of rates, territory served, accessibility to your plant, losses in transit, packaging requirements, speed in handling and transit, and so on?
- Have you decided exactly how your product should be prepared for shipment?

A REPRINT

of this article can be obtained by writing on company letterhead to

The Editor

ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

REPUBLIC AVIATION NEWS

NEW RECONNAISSANCE ROLE FOR "ELECTRONIC PLANE"

NEW PRIME CONTRACT AWARDED REPUBLIC CREATES DEMANDING ASSIGNMENTS FOR EE's & PHYSICISTS

The development of a reconnaissance capability for Republic's F-105D marks the first "marriage" of an all-weather reconnaissance system with an all-weather airborne weapon system. The one-man F-105D has already earned the title of the "world's first electronic plane," because its integrated complex of electronic systems permits it to be almost fully automatic. Flight control, navigation, target seeking, identification and tracking, fire control for diverse weapons are all automatically controlled.

With the addition of a sophisticated reconnaissance system the F-105D becomes a flying electronic platform. System design and analysis of the new reconnaissance package and its aerospace ground support present stimulating new challenges to electronic engineers and physicists. Optimum integration of the whole electronic complex offers unique problems.

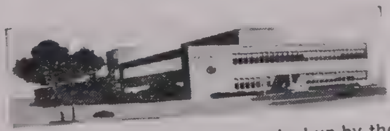
SENIOR & INTERMEDIATE POSITIONS NOW OPEN TO ENGINEERS (EE) AND PHYSICISTS, TO PERFORM SYSTEMS DESIGN, ANALYSIS, TEST AND RELIABILITY ENGINEERING ON:

- Radars (front & side looking)
- Infrared Systems
- Antennas, Radomes
- Data Links
- Digital Computers
- Flight & Fire Control Systems
- High Speed Tape Recorders
- Optical Systems
- Aerospace Ground Support Equipment

These opportunities are at 2 Republic locations: Mineola and Farmingdale, Long Island. For further information, write in confidence to:

▸ Mr. George R. Hickman
Technical Employment Manager,
Dept. 13J
Republic Aviation Corporation
Farmingdale, Long Island, New York

▸ Mr. Paul Hartman
Technical Employment, Dept. 13J-A
Missile Systems Division
Republic Aviation Corporation
223 Jericho Turnpike
Mineola, Long Island, N.Y.



All Republic programs are backed up by the new **Paul Moore Research & Development Center**, an integrated complex of eight laboratories dedicated to the advancement of all aspects of aerospace technology.

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

REPUBLIC
AVIATION CORPORATION

Marketing *(Continued)*

- Where will stocks of your product be maintained?
- Where will servicemen and spare-parts stocks be available if your product requires these?

Competition

- What firms make products that will compete with your product?
- Briefly, what advantages has each competitor over your company? (For example, in terms of nearness to the market.)
- What is the reputation of: Leading competitive firms? Leading competitive products?
- Do you know of competitors or potential competitors who are likely to enter the field with products similar to yours?
- Can anybody bring out a seriously competitive item quickly?
- To what extent do "unrelated" products indirectly compete with your new product?
- Do past, present, and prospective technological developments give any indication of whether this indirect competition will increase in the future?
- Are changes in materials or methods likely to increase your present competitors' sales at the expense of your own?
- Are changes in materials or methods likely to reduce the need for your product?
- Have you discussed with your engineering or research staff all important past, current, and prospective technological trends that may affect your competitive situation?
- Is your name and reputation already established, in the minds of the people who will distribute your new product and the people who will use it, with respect to:
  - Similar products you may already make?
  - A general reputation for quality and engineering progressiveness?
  - A general reputation for dependability, stability, honesty, and fair dealings?

- In the light of your own standing or lack of standing in the market for your new product, is it best to trade on your company name in introducing the product, or would it be easier and more satisfactory to build-up a separate name for the product itself? (Note—It will pay you to investigate the way other companies in your field have handled this problem.)

- Can your product compete favorably with similar products on the market, as to: Price, quality, performance, finish and appearance, durability and length of service, length of service guarantee, other guarantees, package or method of packing, and other respects?

- Has your product received controlled engineering performance tests side by side with the products of your competitors?
- What advantages, if any, can you claim for your product as against those of your competitors?

- Do customers buy your competitors' products mainly on the strength of: Technical specifications? Reputation of the company? Reputation of the brand or trade name? Other factors (for example, reciprocal sales arrangements, company affiliations, personal friendships, etc.)?

- If you cannot match certain special services provided by your competitors, can you provide equal value by quoting lower prices or otherwise? If so, will customers be satisfied? (In practice, buyers are often unwilling to substitute a lower price for special services.)

- Will the internal situation in the industry (reciprocal buying agreements, patent licensing agreements, trading area agreements, and the like) limit the number of prospects?

- In figuring your total sales prospects you have to make allowances for your competitors, unless you think you will have none, or that you can substantially reduce their sales. So by which of the following methods will you carve out your place in the available market: By reducing total competitors' sales for this type of product? By expanding the demand for the product so you can sell your full output without cutting the sales of your competitors? Partly by cutting competitors' sales and partly by increasing total effective demand?

Here's BIG HELP IN TERMINAL WIRING!

The New

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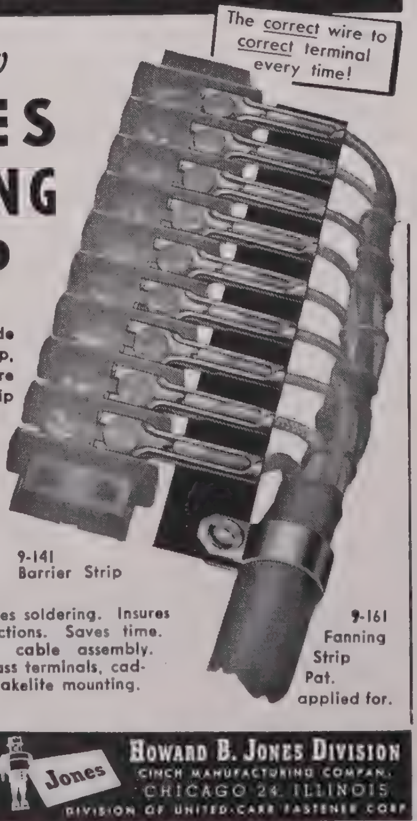

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Price Policy

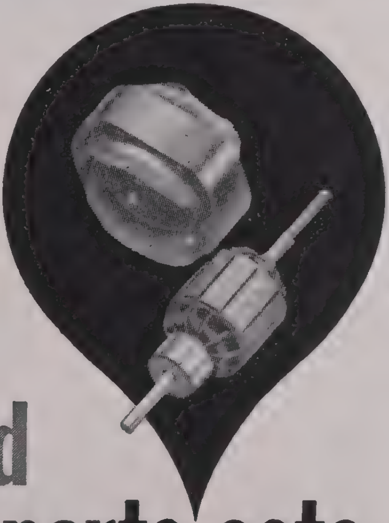
- Do you know, in general, what your price policy will be on this product?
- Have you figured your profit margin as accurately as possible?
- Have you clearly decided whether you want to follow a big-volume-small-margin price policy or a small-volume-big-margin price policy?
- If in your price policy you are shooting at a relatively limited group of prospects, should you further reduce the total potential prospects?
- Are you sure your price schedule on the product will meet the requirements of all your logical prospects?
- Have you considered insurance costs as well as manufacturing and selling costs in determining your price?
- Have you considered all transportation costs and other handling costs?
- Have you considered packaging and packing costs?
- How will installation costs, if any, affect the price policies of you and your distributors?
- Will you service or help service the product? If so, will the user pay you directly for the service?
- Will you expect your distributor to help service the product?
- How will performance guarantees, if any, affect your costs and prices and those of your distributors?
- Will you sell spare parts at cost or at a profit?
- Have you worked out a complete factory price schedule for spare parts?
- If your distributors will also handle spare parts for your product, have you worked out spare-parts price schedules for sales to them and suggested prices for resale to users?
- Have you decided what classes of customers will be entitled to trade discounts?
- Have you determined the schedule of trade discounts to: Distributors? Users (for example, governmental agencies) to whom you may sell direct?
- Will you offer a cash discount to your customers?

Sales Force & Selling

- Have you made some estimate, in terms of direct-selling costs, of what it ought to cost you per unit to promote and sell your product?
- Do you have a sales force which is already handling other products?
- If you do not now have any sales force of your own will you need to create one?
- If you do have a sales force: Can the existing sales force take on your new product and do justice to it without harming the sale of your regular line? Or will you need to change or expand your present organization? Or would it be best to establish an entirely separate sales staff to handle the new product?
- If you decide to expand or change your present organization to handle the new product, will you need to: Increase the size of the staff? Decrease the size of territories? Give your salesmen special training to sell the new product? Take other similar steps?
- Will your salesmen "sell" the new product in the sense of actually closing sales, or will they "negotiate" sales which the management will close? Would sales of the new product be affected favorably or adversely by a business recession?

Advertising and Sales Promotion

- Have you formulated general policies for promoting your product among: Users? Distributors?
- Do you know, in detail, the sales-promotion and advertising methods used by the competitors you will face in this field?
- Do you know the sales-promotion practices followed by distributors in reselling your type of products?
- Do you intend to launch immediately into advertising and sales-promotion activities to boost your product or would it be better to begin later?



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CHANGING JOBS?

—Make sure that you let us know your title, the name and address of your new employer and the products you are concerned with, so that copies of ELECTRONIC INDUSTRIES follow you to your new position.

Write: Circulation Manager,
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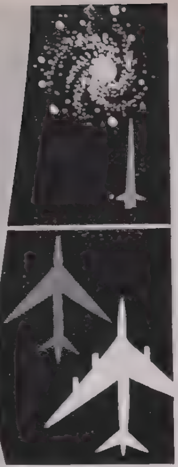
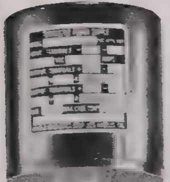


DC TO SINE WAVE *Model KB* (Stock Item)

Input Voltage: . . . . 24-30 VDC
Output Voltage: . . . . 115 VRMS
Output Frequency: . . . 400 cps (other frequencies available)
Output Power: . . . 50 volt-amps
Frequency Regulation: 0.3% for 6 V line variations
Harmonic Distortion (Total): 2% at specified load (4% max.)
Size and Weight: . . 2½"x4"x2½" high; 26 oz.

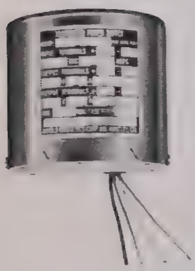
DC TO DC *Model 591HC*

Input Voltage . . . . 24-30 VDC
Output Voltage Range . from 6 VDC to 3500 VDC
Output Power . . 60 watts (max.) regulated
Regulation . . ±1.0% for 6 V line variations; ±1.5% for 50% load variations
Ripple . . . . . . 0.3% RMS
Size and Weight . 3" OD x 3⁵⁄₁₆" high; 22 oz.



DC TO SQUARE WAVE *Model 591ACB*

Input Voltage . . . . 24-30 VDC
Output Voltage Range . 1.0 to 3500 VRMS, square wave, 400 cps (other frequencies available)
Output Power . . . . . 50 V. A.
Regulation . Frequency and Voltage: ±1.0% for 6 V line variations; ±1.0% for 50% load variations
Size and Weight . . 3" OD x 3" high; 19 oz.



Constant frequency, voltage and output as battery discharges. Units withstand short circuit, reversed polarity and input voltage transients of 60 volts. Load power factors as low as 0.2 (lead or lag) may be applied.

Literature with performance curves sent on request. Literature includes "easy to order" information—no need to write complicated specifications.

ARNOLD MAGNETICS CORP.
6050 W. Jefferson Blvd., Los Angeles 16, Calif.
VErmont 7-5313

Circle 106 on Inquiry Card

Marketing *(Concluded)*

- Are most of your prospects already accustomed to using products of this type, or will they have to be taught to use them?

- If they have to be taught, do you have a plan for teaching them?

- What engineering and design features of your product can you especially stress in your advertising and promotional work?

- What message, in general, will be the basis of your advertising appeal?

- Have you determined how much and what type sales-promotion assistance you will need to give your own salesmen to help them sell to distributors or users, or both? (For example, what engineering advice, market data, printed catalogs, drawings, samples, brief-case portfolios, educational slides or films, or scale models could they use?)

- What general advertising and promotional support (for example, catalogs, handout circulars, dealer display materials) will you give your distributors? (Adapt such support carefully to the nature of your product. For example, some small specialty items handled by industrial distributors can be mounted on counter cards for most effective dealer sales promotion.)

- Have you planned sales and service manuals, parts lists, tables of shipping weights and measures, and the like for the use of distributors and users of your product?

- What advertising media will you use? Business papers? Daily newspapers? Direct mail? Telephone directories? Manufacturers' registers? Other media? List. Radio and/television? Consolidated industrial catalogs?

- Do you know whether your competitors are carrying on any newspaper, trade magazines or other organized publicity efforts (as distinguished from advertising) to make their products more familiar and acceptable to distributors and users?

- Do you plan to use such publicity?

Legal and Related Problems

- Is ownership of the new product established? Are you sure you know who controls all the rights in it? (Be careful here when working under government contracts.)

- Are all outstanding claims to royalties or other indemnities settled so that you are sure you have a right to make the product, and on what royalty or other terms you have a right to make it?

- Have you, or whoever else controls the product, secured maximum patent and trademark protection for it?

- What patent or similar restrictions, if any, are there on the production, distribution, sale, or use of your new product? (For example, some patent licensing agreements specify that the licensee shall distribute his output only in certain geographic areas.)

- Are there any such restrictions affecting the production, distribution, sale, or use of parts, accessories, or supplies that are needed to operate, maintain, or repair your new product? If so, what?

- Are any materials, parts, or subassemblies which you need for your new product hedged by similar restrictions? If so, what are the restrictions?

- Do government regulations, (Federal, State, or local) in any way restrict the production, sale, or use of this type of product or significantly raise the costs of producing, marketing, or operating it? If so, how?

- Will marketing agreements or other industry agreements in any way limit the production, sales, or use of your new product?

- Are there any labor or union regulations that might affect the shipment, installation, servicing, or use of your product? If so, what?

- Is there anything in the labeling or advertising of your product that might get you involved in a violation of a Federal, State, or local statute or ordinance?

- Is there anything in your pricing policies, trade practice, or selling setup which might involve a similar violation?

- Have you considered all local licensing and tax problems?

- Are there any other legal problems, peculiar to your product, that you should consider? If so, what are they?

—Abstracted from "Developing & Selling New Products" published by Small Business Administration, U. S. Department of Commerce.

Industry News

E. R. Perry, President, National Vulcanized Fibre Co., Wilmington, Del. —elected Chairman of NEMA's Insulating Materials Div.

Alexander J. White, Jr.—appointed Executive Director of the National Association of Relay Manufacturers.

Robert E. Peterson — Government Industrial Group, Philco Corp., appointed Chairman of Marketing Data Committe, EIA's Industrial Electronics Div.

Dr. Finn J. Larsen—appointed Assistant Secretary of the Army for Research and Development.

Louis L. Smith, Jr.—named Manager of Sales Planning, Motorola Semiconductor Products Inc., Phoenix, Ariz.

L. L. Smith, Jr.

P. L. Chamberlain

Paul L. Chamberlain—named Consulting - Specialist, Computer Dept., General Electric Co., Phoenix, Ariz.

Mark Shepherd, Jr., Vice President Semiconductor-Components Div.— appointed Vice President of over-all Operation, Texas Instruments Incorporated, Dallas, Tex.

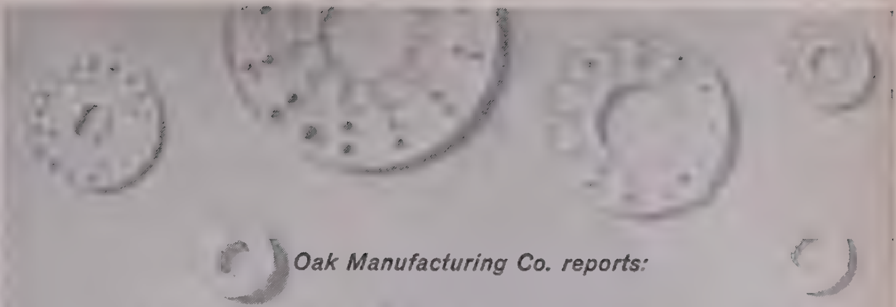
Daniel E. Murphy — appointed Assistant to the President, Consolidated Electro-dynamics Corp., Pasadena, Calif.

Robert W. Curry—named Marketing Manager, Hughes Aircraft Co.'s Vacuum Tube Products Div., Oceanside, Calif.

Maj. Gen. John A. Barclay, (Ret.) U. S. Army—named Vice President for Research and Development, Lionel Corp., Hillside, N. J.

William F. Long—to Head Microelectronics Dept., Lansdale Div., Philco Corp., Lansdale, Pa.

The Bendix Corp. announces the following appointments: **Charles E. Rowett**—Director of Sales and Service, Eclipse-Pioneer Div. Teterboro, N. J.; and **James P. Buckley**—Director of Marketing and Planning, Bendix-Pacific Div., North Hollywood, Calif.



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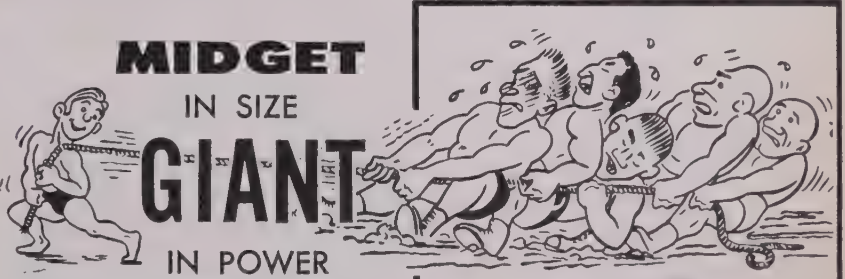

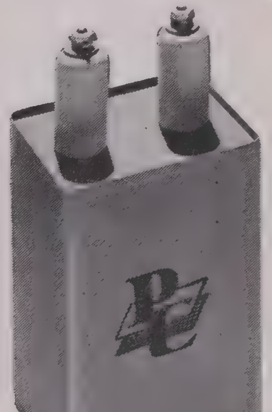

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Industry News

Arnold K. Weber—appointed Staff Vice President, Manufacturing, Radio Corp. of America, New York, N. Y.

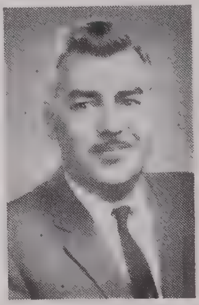
Kendrick H. Lippitt—named Vice President, ASI Pacific Div., Antenna Systems, Inc., Hingham, Mass.

Cramer W. LaPierre—elected Executive Vice President of the General Electric Co., New York, N. Y.

C. P. Dibble—named General Manager, Cinema Plant, HI-Q Div., Aerovox Corp., Los Angeles, Calif.

Gerald L. Phillippe—elected President of the General Electric Co., New York, N. Y.

G. L. Phillippe


W. E. McLean

W. E. McLean—promoted to Vice President of Engineering and Research, Electra Mfg. Co., Kansas City, Mo.

Theodore S. Hoffman—named Vice President and Manager, Semiconductor Div., Hoffman Electronics Corp., Los Angeles, Calif.

Eugene Fioramonti — elected Vice President, Powertron Pacific Corp., Sub. of Powertron Ultrasonics Corp., Plainview, L. I. N. Y.

George Hall—named Sales Manager, Arnold Magnetics Corp., Los Angeles, Calif.

William D. Hogan—named Manager of Engineering Service, Semiconductor Div., Sylvania Electric Products Inc., Woburn, Mass.

Francis L. Ross—named Sales Manager, Micromodular Components, Div., Ling-Temco Electronics, Inc., Anaheim, Calif.

William E. Slusher—to position of Director of Electronics, Transitron Electronic Corp., Wakefield, Mass.

Delco Radio Div., General Motors Corp., Kokomo, Ind., announces the following appointments: **Duane L. Billiet**—appointed Manager, Marketing Services; and **Don C. Cripe**—named Manager, Sales Operations Analysis.

Industry News

John W. Johnson—named Director of Public Relations and Advertising, Ling-Temco-Vought, Inc., Dallas, Tex.

Dr. Patrick Conley—elected Vice President responsible for industry engineering apparatus, service and the newly created Industry Systems Dept., Westinghouse Electric Corp., Pittsburgh, Pa.

Arthur N. Corner—named General Manager, Western Engineering Laboratories Div., Melpar, Inc., Los Angeles, Calif.

Dr. Charles W. Walton—named Vice President for Research, Minnesota Mining & Mfg. Co., St. Paul, Minn.

Paul J. Colleran—named Vice President, Engineering, International Rectifier Corp., El Segundo, Calif.

P. J. Colleran

K. M. Lord

Kenneth M. Lord—elected Vice President, Manufacturing and Purchasing, Raytheon Co., Lexington, Mass.

David R. Hull—has joined Boyden Associates, Inc., New York, N. Y., consultants to management on executive selection.

Neil M. Blair, President, RF Products Div., Amphenol-Borg Electronics Corp.—named President of Amphenol-Borg's FXR Div., Broadview, Ill.

James D. Warren, Vice President, Engineering, Dorsett Electronics, Inc.—appointed General Manager, Electronic Laboratories Div., Dorsett Electronics, Inc., Norman, Okla.

Gerald C. Schutz—named Vice President of Vitro Electronics, div. of Vitro Corp. of America, New York, N. Y.

L. F. Yost, Jr.—named Manager, Manufacturing, General Electric's Light Military Electronics Dept., Utica, N. Y.

Jack T. Gentry—appointed Vice President and General Manager, U. S. Engineering Co., division of Litton Industries, Van Nuys, Calif.

News of Mfrs' Representatives

Navigation Computer Corp., Valley Forge Industrial Park, Norristown, Pa., announces the appointments of: **Bard Associates**, Riverside, Ill., to cover Illinois, Indiana, Wisconsin, and Iowa; **M. J. McDonald Co.**, Pfafftown, N. C., for North and South Carolina and Tennessee; and **The Tiby Co.**, Cleveland, Ohio, for Michigan, Ohio and Western Pennsylvania.

Ace Electronics Associates, Inc., Somerville, Mass., announces the appointments of: **Delta Sales Co.**, Indianapolis, Ind., to cover Indiana and Kentucky and **Robert G. Siff & Associates**, Dayton, Ohio, for U. S. Naval Avionics Facility, Wright-Patterson AFB and Gentile AFB.

Electrical Agencies, Inc., Boston, Mass., appointed to represent Sola Electric Co., Elk Grove Village, Ill., in the New England area.

Rocke International, Inc., has been appointed worldwide export representative for Times Wire & Cable, div. of The International Silver Co., Wallingford, Conn.

J. T. Hill Co. named representatives for Power Sources, Inc., Burlington, Mass., in the states of California, Arizona, Nevada, and Hawaii.

Monitor Products Co., So. Pasadena, Calif., announces the appointments of: **R. P. Kennedy Co.**, Rochester, N. Y., to cover the greater New York state area; **The Gene F. Straube Co.**, Sunnyvale, Calif., for North California; and **Harry J. White Co.**, Haddonfield, N. J., to cover Southern New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and West Virginia.

BMI Graduates

Graduates of ERA's BMI at American Univ., Washington, D. C. (L-r outside table): H. Segel, J. Jopson, R. Trinkle, E. Burroughs, J. Fields, Prof. W. Muhlbach, Dean N. Baily, M. Taylor—Institute Chairman, Col. H. Wheaton, P. Andress—Chairman BMI, Dr. O. Johnson, R. Tydings, C. Lienau, M. Brimberg, B. Houser, P. Weidenbacher, E. Rosen. (L-r inside table): R. Wilkinson, R. Grubb, H. Lavin, T. Adams, A. Cert, F. Tylinski, R. Morgan—ERA Dir. of Ed. and absent T. Greenberg.

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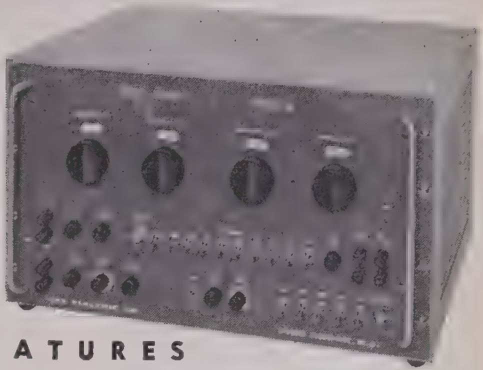

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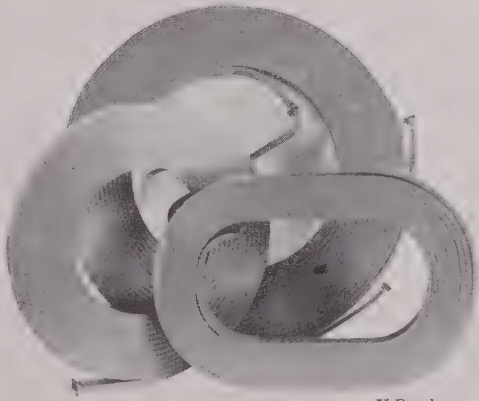
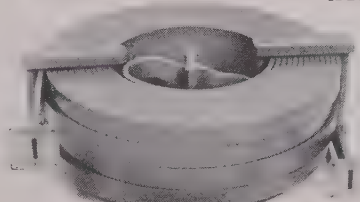


X Band



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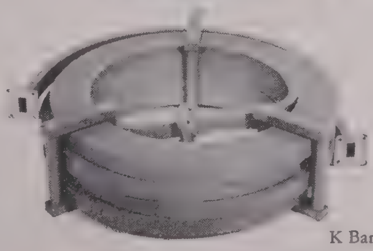

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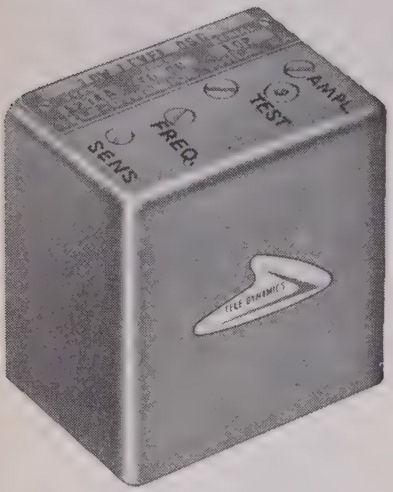

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Designed to operate at unlimited altitudes, the 1274A can be activated by a ± 5 millivolt level differential signal. The input impedance is greater than 90 K ohms. It is extremely stable, has true differential floating input, and inherent deviation limiting which prevents over-deviation of greater than ± 22% from center frequency. Common mode rejection is 110 db min. for a 10 volt peak to peak AC signal up to 2100 cycles. Silicon transistors allow operation over broad temperature ranges and latest packaging techniques reduce the volume of the 1274A to only 4.5 cu. in. and its weight to approximately 4 ounces.

For detailed technical bulletins, call the American Bosch Arma marketing offices in Washington, Dayton or Los Angeles. Or write or call Tele-Dynamics Division, American Bosch Arma Corporation, 5000 Parkside Avenue, Philadelphia 31, Pa. Telephone: TRinity 8-3000.

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TELE-DYNAMICS
DIVISION
AMERICAN BOSCH ARMA
CORPORATION
5000 Parkside Ave., Philadelphia 31, Pa.

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News of Mfrs' Representatives

Burnell & Co., Inc., Pelham, N. Y., announces the appointments of: **Aztec Enterprises**, Albuquerque, N. Mexico, to cover New Mexico and El Paso County, Tex.; and **Claude Booth & Associates**, Chicago, Ill., to cover Illinois and Wisconsin.

Du-Val Industrial Foreign Trade Corp., Dallas, Tex., has been named representatives for General Electrodynamics, Garland, Tex., and Computers, Inc., Houston, Tex.

Arthur B. Mayer has joined the sales staff of Hutmacher Associates, Chicago, Ill.

Columbia Wire and Supply Co., Chicago, Ill., announces the appointments of: **Tamsco**, Memphis, Tenn., to cover the states of Arkansas and Louisiana; and **Technical Sales Associates**, San Francisco, Calif., to cover California North of Fresno, and Nevada.

Donald A. FitzGerald named technical representative for Alpha Metals, Inc., Jersey City, N. J., to cover Massachusetts, Vermont, New Hampshire, Rhode Island and Connecticut.

Engineered Electronics Co., Santa Ana, Calif., announces appointments of **TESTCO**, Seattle, Wash., to cover Washington, Oregon, Montana, and Northern Idaho, and **R. R. Thomas Co.**, to cover Oklahoma, Kansas, Arkansas, Louisiana and Texas except El Paso County.

Western Control Equipment Co., Sherman Oaks, Calif., has been named representative for Polyphase Instrument Co., Bridgeport, Pa., to cover Southern California and Arizona.

James R. Eberly Co., Washington, D. C., has been named representative for Shockley Transistor, unit of Clevite Transistor, Palo Alto, Calif., to cover Delaware, Maryland, N. Carolina, Virginia and Washington, D. C.

John A. Rowe & Associates, Westminister, Colo., named sales representative for Midwestern Instruments, Inc., Tulsa, Okla., to cover Colorado, Wyoming, Utah, Idaho, Eastern Montana, New Mexico, Arizona and West Texas.

Northeast Electronics Distributors, Inc., Hartford, Conn., has been named representatives for Cambridge Thermionic Corp., Cambridge, Mass.

Skydyne, Inc., Port Jervis, N. Y., has appointed **E. C. Raymund and Associates**, of Orlando and St. Petersburg, Fla., as representatives for the states of Florida, Georgia, Alabama, Tennessee, and North and South Carolina.

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This index is published as a convenience. No liability is assumed for errors or omissions.

A

Acoustica General Ultrasonics Division 190
Adams & Westlake Company, The 184
ADC, Division of Magnetic Controls Company 84
Alfa Metals, Inc. 208
Allen-Bradley Co..........Insert following p. 138
Allied Chemical, General Chemical Division 31, 198
Allied Control Company, Inc. 129
Allied Radio 220
American Bosch Arma Corp., Tele-Dynamics Div. 210, 226
American Electrical Heater Co. 172
American Machine & Foundry Co. 164
American Semiconductor Corp. 174
American Sterilizer 129
American Time Products, Inc. 16
AMP Incorporated 39
Antenna Systems Inc. 182
Arco Electronics Inc. 165
Armco Division, Armco Steel Corporation .. 40
Arnold Magnetics Corp. 222
Arnold Engineering Company, The 85
Associated Research, Inc. 228

B

Ballantine Laboratories, Inc. 62
Belden Company ....Insert following p. 190
Bendix Corporation
  Semiconductor Division 180-181
  Pioneer-Central Division 159
  M. C. Jones Electronics Co., Inc. 70
Booker & Wallestad, Division of Thermotech Industries, Inc. 223
Bourns, Inc. 137
Bruno-New York Industries Corp. 210
Brush Instruments Division of Clevite Corporation ....Insert following p. 88
Bussmann Mfg. Division, McGraw-Edison Co. 34

C

Cambridge Thermionic Corporation 174
Centralab The Electronics Division of Globe-Union 37
Chicago Dynamic Industries, Inc.
  Precision Products Division 190
Cinch Manufacturing Company 123
Clevite Transistor, Division of Clevite Corp. ....Insert following p. 156
Computer Diode Corporation 9
Conrac Division, Giannini Controls Corporation 83
Consolidated Vacuum Corporation 76
Continental Connectors 30
Controls Company of America, Control Switch Division 131
Corning Electronic Components, Corning Glass Works 78

D

ale Electronics, Inc., A Subsidiary of Hathaway Instruments, Inc. 41
aven Company, The 208
elco Radio Division of General Motors 77, 162-163
ialight Corporation 211
orsett Electronics, Inc., Electronic Organ Division 181

E

ICO Electronics Instrument Co. 211
lgin Advance Relays, The Electronics Division of Elgin National Watch Company .. 33
xact Electronics, Inc. 38

F

Fairchild Semiconductor Division of Fairchild Camera and Instrument Corporation 173
Fairchild Controls Corp. 189
Film Capacitors, Inc. 175
John Fluke Mfg. Co., Inc. 35
Frequency Standards, A Division of Harvard Industries, Inc. 48

G

General Communication Co. 179, 187
General Electric Company
  HMED 217
  Power Tube Department 58
  Rectifier Components Div. 68, 69
  Semiconductors Products 82
General Instrument Semiconductor Division.. 161
General Radio Company 59
Good-All Electric Mfg. Co. 61
Graphic Systems 181
Grayhill, Inc. 209
G-V Controls Inc. ....Inside Back Cover

H

Harman Kardon Data Systems Division 36
Hewlett-Packard Co...Insert following p. 52, 44-45
Honeywell, Military Products Group 135
  Precision Meters 46
Howard Industries, Inc. 221

I

Ideal Industries, Inc. 159
Industrial Electronic Engineers, Inc. 226
Industrial Test Equipment Co. 175
Inland Motor Corporation of Virginia, A Subsidiary of Kollmorgen Corporation ... 43
International Resistance Company 73

J

Jennings Radio Mfg. Corp. 168
Johnson Co., E. F. 167
Jones Division, Howard B., Cinch Mfg. Co... 220

K

Kay Electric Company 225
Keuffel & Esser Co. 171
Keystone Carbon Company, Thermistor Division 56
Klein & Sons, Mathias 177

L

Lavelle Aircraft Corporation 160
Lenz Electric Manufacturing Co. 166
Lepel High Frequency Laboratories, Inc. .. 164
Litton Industries Electron Tube Division ... 79

M

Magnetics Inc. 133
Microwave Associates, Inc., Semiconductor Division 81
Mueller Brass Co. 46-47

N

National Cash Register Company, The 212
Nothelfer Winding Laboratories, Inc. 66

O

Oak Manufacturing Co. 27
Ohmite Manufacturing Company 75

P

Pacific Semiconductors, Inc. 13
Philbrick Researches, Inc. 186
Philco Lansdale Division 24
Plastic Capacitors, Inc. 223
Polarad Electronics Corporation 86-87
Power Designs Inc. 211
Precision Instrument Company 80

R

Radio Corporation of America ......Back Cover
Radio Materials Company ...Inside Front Cover
Rayclad Tubes Incorporated 22
Raytheon Company
  Industrial Components Division 74, 167
  Semiconductor Division 49
Reeves Soundcraft Corp. 127
Republic Aviation Corporation 219
RF Products Division of Amphenol-Borg Electronics Corp. 185
Rohn Manufacturing Company 88

S

Sarkes-Tarzan Inc., Semiconductor Division ....Insert following p. 16
Sealectro Corporation 176
Sensitive Research Instrument Corporation .. 125
Shallcross Manufacturing Co. 12
Shockley Transistor Unit of Clevite Transistor 26
Shure Brothers, Incorporated 171
Sola Electric Co. 192
Sonotone Corp., Electronic Application Division 178
Spectromagnetic Industries 42
Sperry Semiconductor Division of Sperry Rand Corp. 205
  Electronic Tube Division 57
Sprague Electric Company 6, 14
Stackpole Carbon Co. 21
Stevens Manufacturing Company, Inc. 10
Stromberg-Carlson-General Dynamics/-Electronics 187
Sylvania Electric Products Inc., Electronic Tubes Division ...169, Insert following p. 70
  Semiconductor Division 63

T

Taylor Fibre Co. 52
Tektronix, Inc. 64
Telerad Division of the Lionel Corporation .. 203
Telonic Industries, Inc. 207
Toledo Edison Company, The 188
Transitron Electronic Corporation 65
Turbo Machine Co. 225

U

United Aircraft Corporation, Hamilton Standard Division 90
United Transformer Corporation 204
United Van Lines 50

V

Vapor Heating Corporation, Vap-Air Division 51
Vector Manufacturing Co., Inc. 224

W

Waveline, Inc. 138
Western Electric 67
Western Rubber Co. 172
Western Sky Industries 226
White Avionics Corporation 55
White, S. S., Industrial Division 170

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2N292, 2N293 NPN ¢45 @ . . . . . . 12 for $5, 100/$37
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Sounding Rocket Attempts To "Trap" Micrometeorites

An Aerobee-Hi sounding rocket has been fired more than 101 miles above the New Mexico desert in an attempt to trap and recover extraterrestrial dust from outside the earth's atmosphere. These dust particles or micrometeorites, measured in microns, pose a potential threat to space travelers. Despite their small size, their high velocity makes them as lethal as bullets.

Scientists from the Air Force Cambridge Research Laboratories will examine the payload and determine whether or not specimens of these "dusty space bullets" were captured. By recovering the dust, they hope to establish a method of observing micrometeorites from ground stations, instead of through the more elaborate technique of launching rockets above the atmosphere. At present researchers do not have enough information on this space dust to distinguish it from dust of terrestrial origin.

Oceanographic Project

Telemetering Corp. of America, a subsidiary of Pacific Mercury Electronics, Sepulveda, Calif., has been selected to design and develop the telemetering system to be used on a multimillion dollar oceanographic research project in the Gulf of Mexico. The project is sponsored by the office of Naval Research in cooperation with Texas A & M. Initial research is planned to establish an automatic measurement and data system which will service a variety of air-sea environmental studies.

Expanding use of the sea frontier is resulting in increased oceanograph research by both the U. S. Government and private sources. In the past three years hundreds of millions of dollars have become available for projects relating to underwater communications, tracking, sound propagation, electronic wave action, and similar programs.

Recruiting Ads Drop

December figures on recruitment advertising show the sharpest drop in 6 months. The drop is regarded by Deutsch & Shea, 230 W. 41st St., N.Y., compilers of the information, as an expected seasonal reaction. This is due in part to a demonstrated reluctance on the part of professional men to consider job changes during the holiday season.

System Illustrates Advances in Automation

Illustrating the advances in automation in clinical investigation and research is a Technicon AutoAnalyzer. Developed by Technicon Controls, Inc., of Chauncey, New York, the system is capable of conducted pharmacodynamic studies of blood and other body fluids in vivo and over extended periods of time.

The AutoAnalyzer will provide a continuous written record of a given pharmaceutical in the blood stream. This is in contrast to conventional techniques involving periodic withdrawals of blood from the patient by manual means. Physiologic effects of the administered agents are clearly monitored and recorded. The agent's effectiveness may also be plotted simultaneously.

Air Traffic Control Projection Display

A prototype Bright Display for use in air traffic surveillance and control has been delivered to MITRE Corp. by General Dynamics/Electronics, San Diego, Calif. Named the S-C 2000 Bright Display, the unit displays alphanumeric, symbolic and graphic data simultaneously with video presentations. It combines use of the Charactron shaped beam tube and a completely dry printing process to provide bright, fail-safe, flicker-free displays at speeds under two seconds for each complete display.

The company plans to use the equipment in command and control systems studies as well as for experimental programs in SATIN (Sage Air Traffic Integration) to advance air traffic control technology. MITRE, under contract with the FAA and the USAF, is studying the possible application of the Sage air defense system to serve as a combined military-civilian air surveillance and control system.

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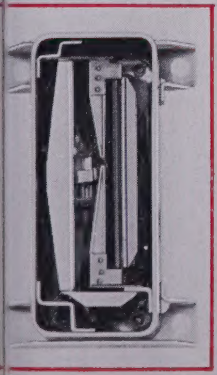

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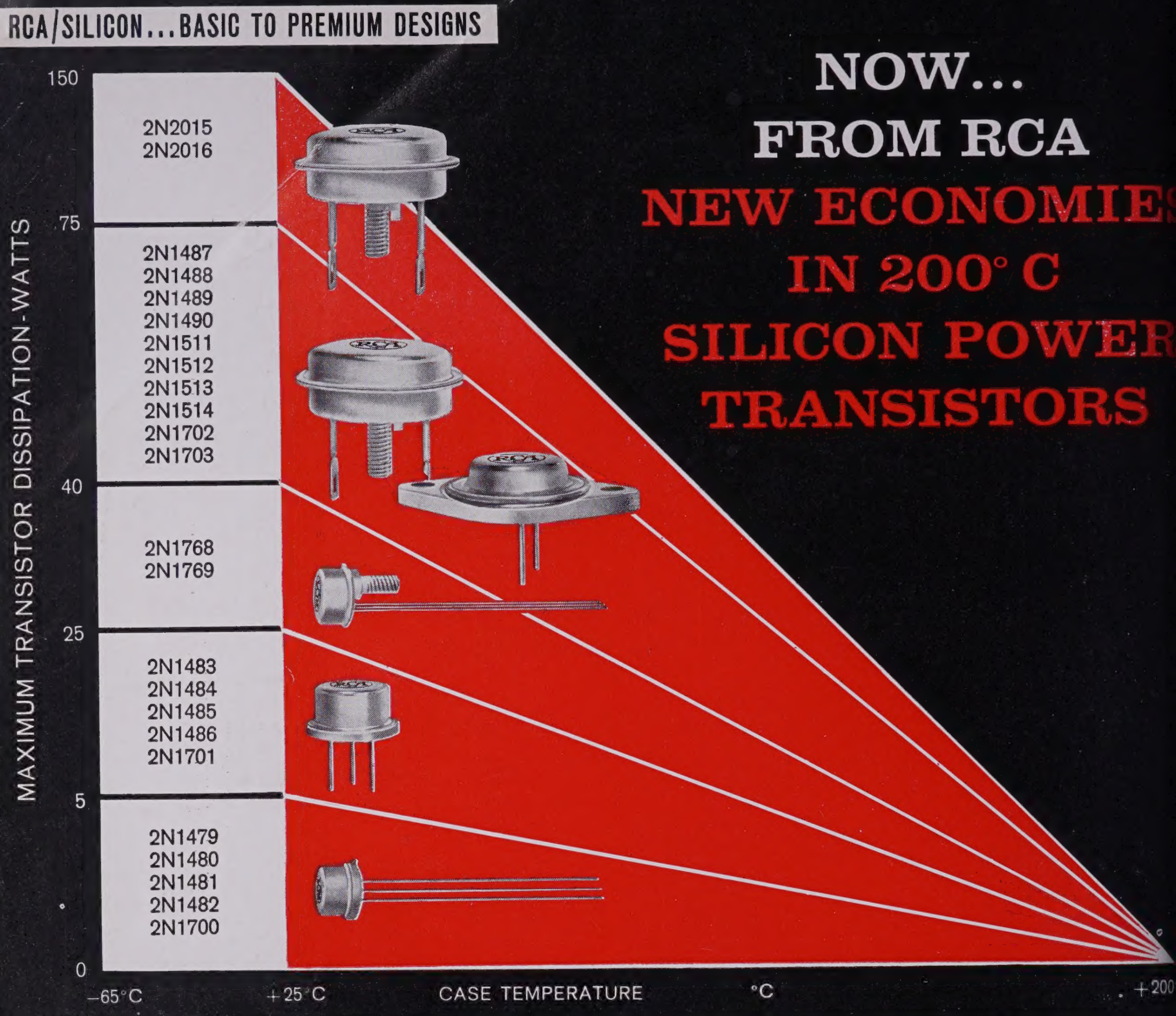

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